Ministry of the Environment

Ontario

STANDARDS DEVELOPMENT BRANCH OMOE
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Final Report

Waste Site Identification Study

Phase II, Part II
Verification Studies

West Central Region

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Ministry of the Environment

Ontario

Final Report

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Phase II, Part II
Verification Studies

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February, 1983
Ref. No. 0913

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February 9, 1983

Reference No. 913

Mr. Les A. Ficzere, P. Eng.
Waste Management Branch
Ministry of the Environment
135 St. Clair Avenue West
Toronto, Ontario
M4V 1P5

Dear Les:

Re: Final Report - Waste Site Verification Study
Phase II - Part II - West Central Region

We are pleased to submit twenty (20) copies of our final report on the Phase II - Part II, Waste Identification Study (Verification Study) for the West Central Region. This report describes the study methodology, field investigation program and results and assesses the Phase II - Part I Study along with formulating conclusions and recommendations on the overall program.

Should you have any questions on this report, please do not hesitate to contact us.

Yours very truly,

CONESTOGA-ROVERS & ASSOCIATES LIMITED

Anthony J. Crutcher, P. Eng.

AJC/mm
Encl.

TABLE OF CONTENTS

		PAGE
1.0	INTRODUCTION	1
2.0	STUDY METHODOLOGY	5
	2.1 GENERAL	5
	2.2 METHODOLOGY	6
3.0	SITE NO. 0044 - THOROLD	15
	3.1 BACKGROUND	15
	3.2 FIELD INVESTIGATION	19
	3.3 EXPANDED FIELD INVESTIGATION	22
	3.4 HYDROLOGY	25
	3.5 WATER QUALITY	27
	3.6 AREAS OF WASTE DISPOSAL	33
	3.7 LEACHATE PRODUCTION AND LOADING	34
	3.8 COMBUSTIBLE GAS MONITORING	35
	3.9 COMBUSTIBLE GAS GENERATION	38
	3.10 SUMMARY	40
	3.11 RESULTS OF SITE INVESTIGATION, PHASE II-PART I	44
4.0	SITE NO. 0062 - GRIMSBY	47
	4.1 BACKGROUND	47
	4.2 FIELD IVESTIGATION	49
	4.3 SUMMARY	49
	4.4 RESULTS OF SITE INVESTIGATIONS, PHASE II - PART I	50

TABLE OF CONTENTS (Cont'd)

		PAGE
5.0	SITE NO. 0084 - WATERLOO	51
5.1	BACKGROUND	51
5.2	FIELD INVESTIGATION	53
5.3	HYDROLOGY	55
5.4	WATER QUALITY	59
5.5	LEACHATE PRODUCTION AND LOADING	68
5.6	COMBUSTIBLE GAS MONITORING	70
5.7	COMBUSTIBLE GAS GENERATION	72
5.8	SUMMARY	73
5.9	RESULTS OF SITE INVESTIGATIONS, PHASE II - PART I	76
6.0	CONCLUSIONS AND RECOMMENDATIONS	78
6.1	VERIFICATION SITES	78
6.2	PHASE II - PART I ASSESSMENT	80
6.3	SITES REQUIRING FURTHER INVESTIGATION	83

APPENDIX A TERMS OF REFERENCE

APPENDIX B SITE NO. 0044 - THOROLD
- TABLE B-1 Water Well Logs
- TABLE B-2 Stratigraphic & Instrumentation Logs
- TABLE B-3 Borehole Logs from Portable Auger
- TABLE B-4 Phase I - Part I Study Report for Site No. 0042, 0043, and 0044

APPENDIX C SITE NO. 0062 - GRIMSBY
- TABLE C-1 Water Well Logs
- TABLE C-2 Statigraphic and Instrumentation Logs
- TABLE C-3 Phase II - Part I Study Report for Site No. 0062

APPENDIX D SITE NO. 0084 - WATERLOO
- TABLE D-1 Water Well Logs
- TABLE D-2 Stratigraphic and Instrumentation Logs
- TABLE D-3 Phase II - Part I Study Report for Site No. 0084

LIST OF FIGURES

		Page
FIGURE 1.1	KEY MAP	4
FIGURE 2.1	TESTHOLE WITH TYPICAL GAS PROBE AND OBSERVATION WELL DETAIL	9
FIGURE 2.2	TYPICAL GAS PROBE DETAIL	10
FIGURE 2.3	TYPICAL OBSERVATION WELL DETAIL	12
FIGURE 3.1	LOCATION OF SITE NO. 0044	16
FIGURE 3.2	LOCATION OF OLD WELLAND CANAL	17
FIGURE 3.3	GRAIN SIZE DISTRIBUTION	21
FIGURE 4.1	LOCATION OF SITE NO. 0062	48
FIGURE 5.1	LOCATION OF SITE NO. 0084	52
FIGURE 5.2	GRAIN SIZE DISTRIBUTION	56

LIST OF TABLES

TABLE 3.1	WATER LEVELS	26
TABLE 3.2	WATER ANALYSIS RESULTS	29
TABLE 3.3	COMBUSTIBLE GAS LEVELS	37
TABLE 3.4	COMPREHENSIVE GAS ANALYSIS	39
TABLE 5.1	WATER LEVELS	58
TABLE 5.2	WATER ANALYSIS RESULTS	61
TABLE 5.3	COMBUSTIBLE GAS LEVELS	71

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LIST OF MAPS

		Page
MAP 3.1	WASTE SITE IDENTIFICATION STUDY PHASE II - PART I WASTE SITE #0044 - THOROLD - SITE PLAN 1	Enclosed
MAP 3.2	WASTE SITE IDENTIFICATION STUDY PHASE II - PART I WASTE SITE #0044 - THOROLD - SITE PLAN 2	Enclosed
MAP 4.1	WASTE SITE IDENTIFICATION STUDY PHASE II - PART I WASTE SITE #0062 - GRIMSBY - SITE PLAN	Enclosed
MAP 5.1	WASTE SITE IDENTIFICATION STUDY PHASE II - PART I WASTE SITE #0084 - WATERLOO - SITE PLAN	Enclosed

1.0 INTRODUCTION

In 1979, the Ministry of the Environment, Waste Management Branch, investigated the Phase I Program of the Waste Site Identification Study. The program was completed by three Ontario Universities and involved a survey and preparation of a master list of waste disposal sites in operation in Ontario prior to 1971. Subsequently, the list of sites were prioritized, based upon potential hazards, in three groups - Priority Group No. 1, Priority Group No. 2, and Priority Group No. 3.

In September 1980, Phase II of the Waste Site Identification Study was undertaken in the West Central Region by the firm of Gartner Lee Associates Limited. This work was conducted on the Priority No. 1 sites as selected by the Ministry of the Environment and consisted of a review of 47 sites within the West Central Region. In November 1980, a final report on the study of the 47 sites in the West Central Region was presented to the Ministry of the Environment. A similar work program was conducted by other consultants for each of the other Regions within Ontario.

In August 1982, the consulting engineering firm of Conestoga-Rovers & Associates Limited was commissioned to conduct the Phase II - Part II

investigation of the Waste Study Identification Study. Appendix A presents the Terms of Reference for this study.

The purpose of the Phase II - Part II Waste Site Identification Study is as follows:

1) Investigate the public health and safety, and the existing and potential environmental hazards at the selected sites by conducting detailed hydrologic, hydrogeologic and leachate and gas generation/migration studies.

2) Assess the methodology used and the results obtained during the preliminary field studies (Phase II - Part I) for each of the verification studies as compared to the more detailed investigation conducted under this program.

3) Based on the results of the verification study, recommend if any additional sites should be investigated/re-investigated from the Phase II - Part I Site Investigation Study.

The three sites defined by the Ministry of the Environment under the Phase II - Part II site verification studies for the West Central Region are

Site No. 0044 - Thorold, Site No. 0062 - Grimsby and Site No. 0084 - Waterloo. Figure 1.1 locates these sites on a Key Map.

The following report describes the methodology used for the Phase II - Part II study for the West Central Region; outlines the field investigation and monitoring program conducted at each site; summarizes the environmental impact for each site; compares the results of this more comprehensive study to the preliminary study described in Phase II - Part I; reviews the methodology used for Phase II - Part I and presents an assessment of that methodology utilizing the information collected from the Phase II - Part II study; based upon the above, recommendations are formulated if additional studies should be carried out at any of the remaining sites identified under Phase II - Part I.

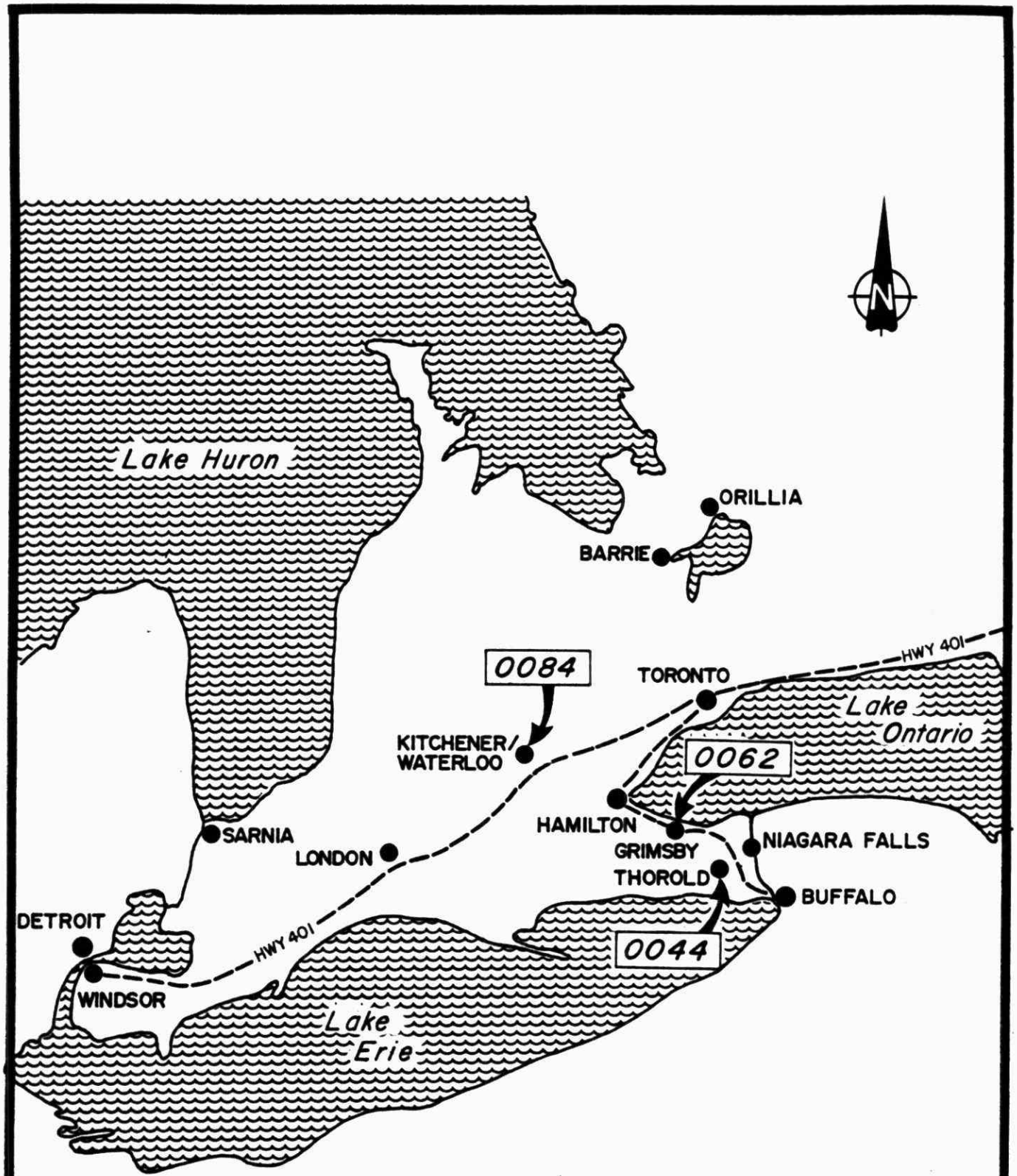

figure 1.1

KEY MAP
WASTE SITE IDENTIFICATION STUDY
Verification Studies

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2.0 STUDY METHODOLOGY

2.1 GENERAL

As detailed in the Terms of Reference (Appendix A), the purpose of conducting the Verification Study is to independently assess the sites' public health and safety, and environmental hazard, and compare the results and the validity of the technique used in the Preliminary Field Studies (Phase II - Part I).

To properly identify the environmental hazard from a waste disposal site the following items were addressed for each site:

1) Waste type, age and character.

2) Aerial extent of waste disposal.

3) Leachate characteristics and quantity.

4) Groundwater flow hydraulics.

5) Leachate migration/attenuation.

6) Existing and potential hazards from leachate generation and migration.

7) Landfill gas generation.

8) Landfill gas migration.

9) Existing and potential hazards from landfill gas generation and migration.

10) Surface water flow hydraulics.

11) Existing and potential hazard leachate discharge to surface water courses.

12) Site development control.

2.2 METHODOLOGY

The following outlines the methodology which was undertaken at each site to identify whether a hazard exists to the public health, public safety or to the environment from the waste disposal site.

1) Site History - discussions were held with representatives of the municipality/owner to

ascertain the background history of the site, and obtain all pertinent data which may be available. Permission was obtained to conduct the field investigation program and the subsequent monitoring. In addition all background material available from the Ministry of the Environment was obtained and evaluated prior to conducting the field investigation program.

2) Regional Hydrology and Hydrogeology - prior to conducting any on-site field investigation, both the regional hydrology and hydrogeologic characteristics were determined. Information from the well logs on file with the Ministry of the Environment, published geologic reports and any other data which may be available was used to determine the regional soils stratigraphy and groundwater flow hydraulics. Topographic maps and drainage maps were reviewed to determine the surface water flow hydraulics.

3) Site Inspection - prior to conducting the field investigation program, a general inspection of the site was conducted to determine the characteristics of the area and locate the groundwater and gas monitoring points. Off-site, a survey was conducted of adjacent buildings to determine if a

private well was available for monitoring (both groundwater level and chemistry) and arrange access for the installation of gas monitoring probes, observation well(s) and subsequent monitoring.

4) Field Investigation Program

a) Where possible, a backhoe was used to excavate test holes to identify the aerial extent of refuse disposal, install gas probes, and if groundwater was encountered, install standpipes. Figure 2.1 presents a typical detail of the gas probe and observation well installation. If it was not possible to use a backhoe at the site, a drill rig was used for determining the aerial extent of waste.

b) A motorized auger was used to install shallow gas probes both on the site and radially away from the site. Figure 2.2 presents a typical gas probe installation detail. These probes were used to determine if landfill gas was being generated for migrating from the site. In addition, gas probes will be installed adjacent to foundation walls of building near the disposed waste (subject to owner permission).

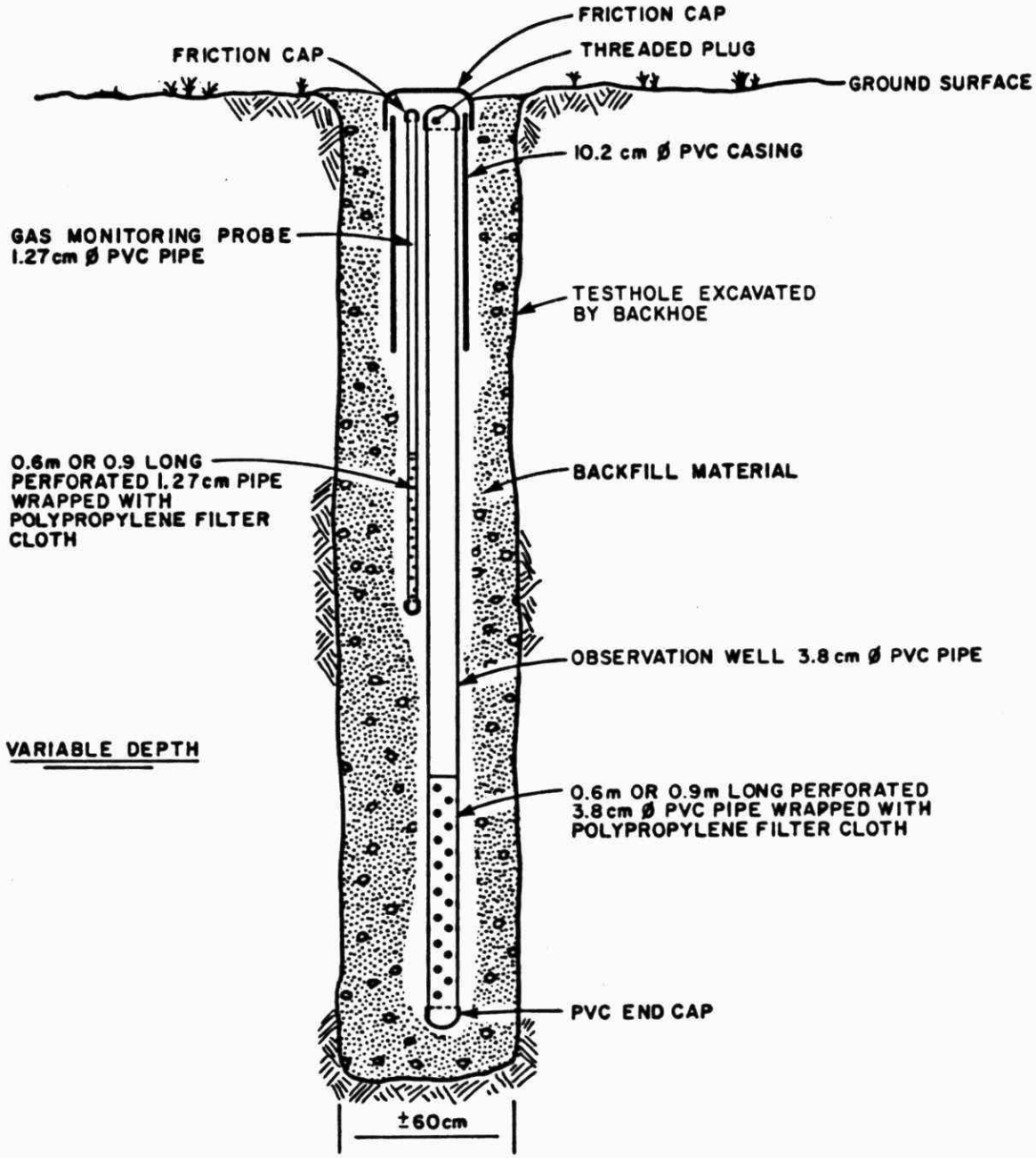

figure 2.1

TEST HOLE WITH TYPICAL
GAS PROBE AND OBSERVATION WELL DETAIL

Waste Site Identification Study

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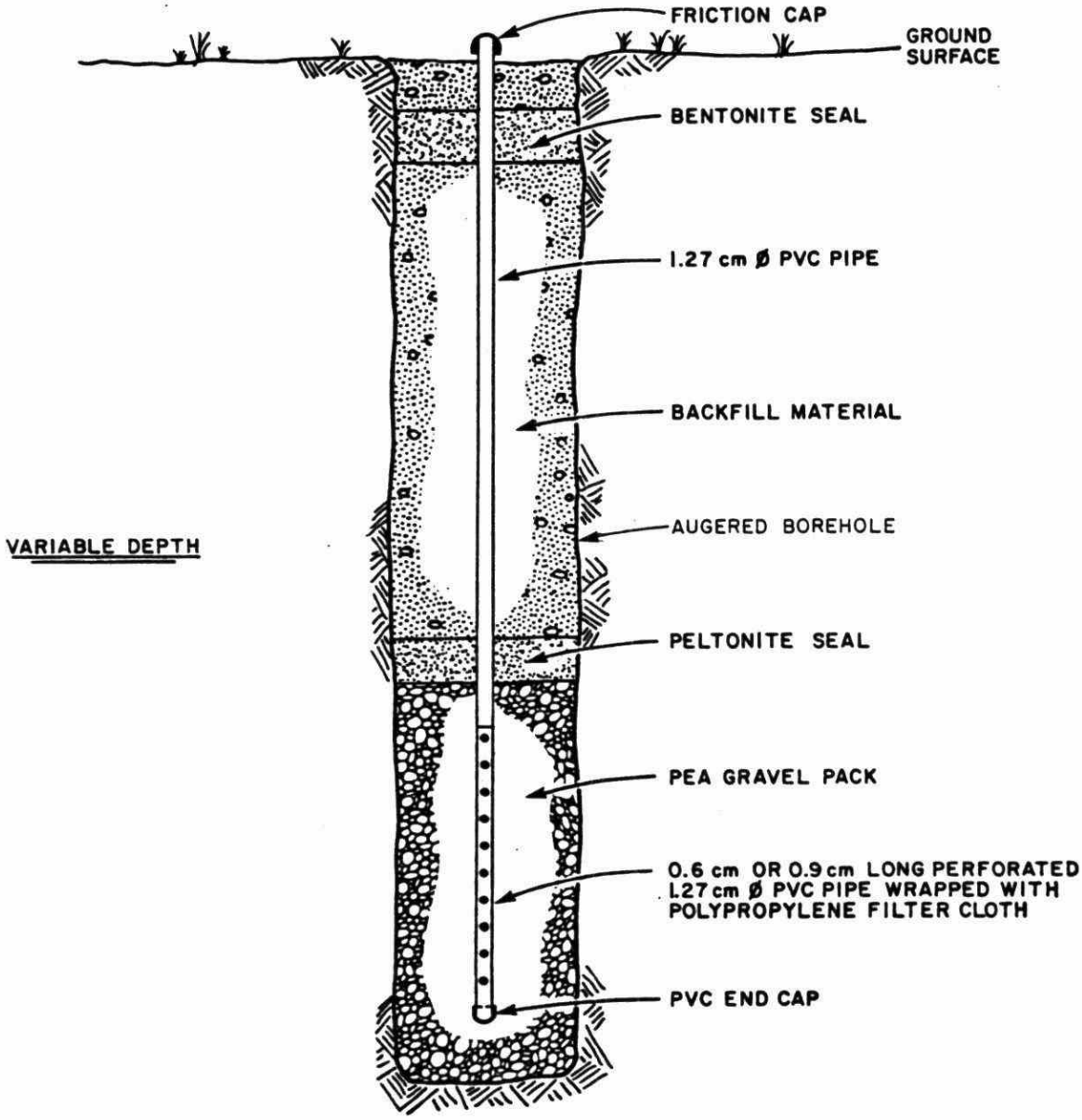

figure 2.2
TYPICAL GAS PROBE DETAIL
Waste Site Identification Study

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c) A drilling rig using hollow stem augers was used to determine the at-depth soil stratigraphy, obtain soil samples (up to three representative soil samples were analyzed for grain size distribution) and installation of observation wells to determine the groundwater flow hydraulics and chemistry. Figure 2.3 presents a typical observation well detail. In addition, the drill rig was used to install a leachate monitoring well at the base of refuse. The observation wells/standpipes were installed in such a fashion, to determine both the vertical and horizontal components of the groundwater flow. Gas probes were nested with the observation wells in the unsaturated portion.

d) A level/stadia survey of the site and surrounding area was undertaken to identify the local topographic features, prepare a contour map, surface water levels, locate and determine elevations for all standpipes and observation wells.

5) Monitoring

a) After the installation of the observation wells, all wells were hand bailed and the water tested

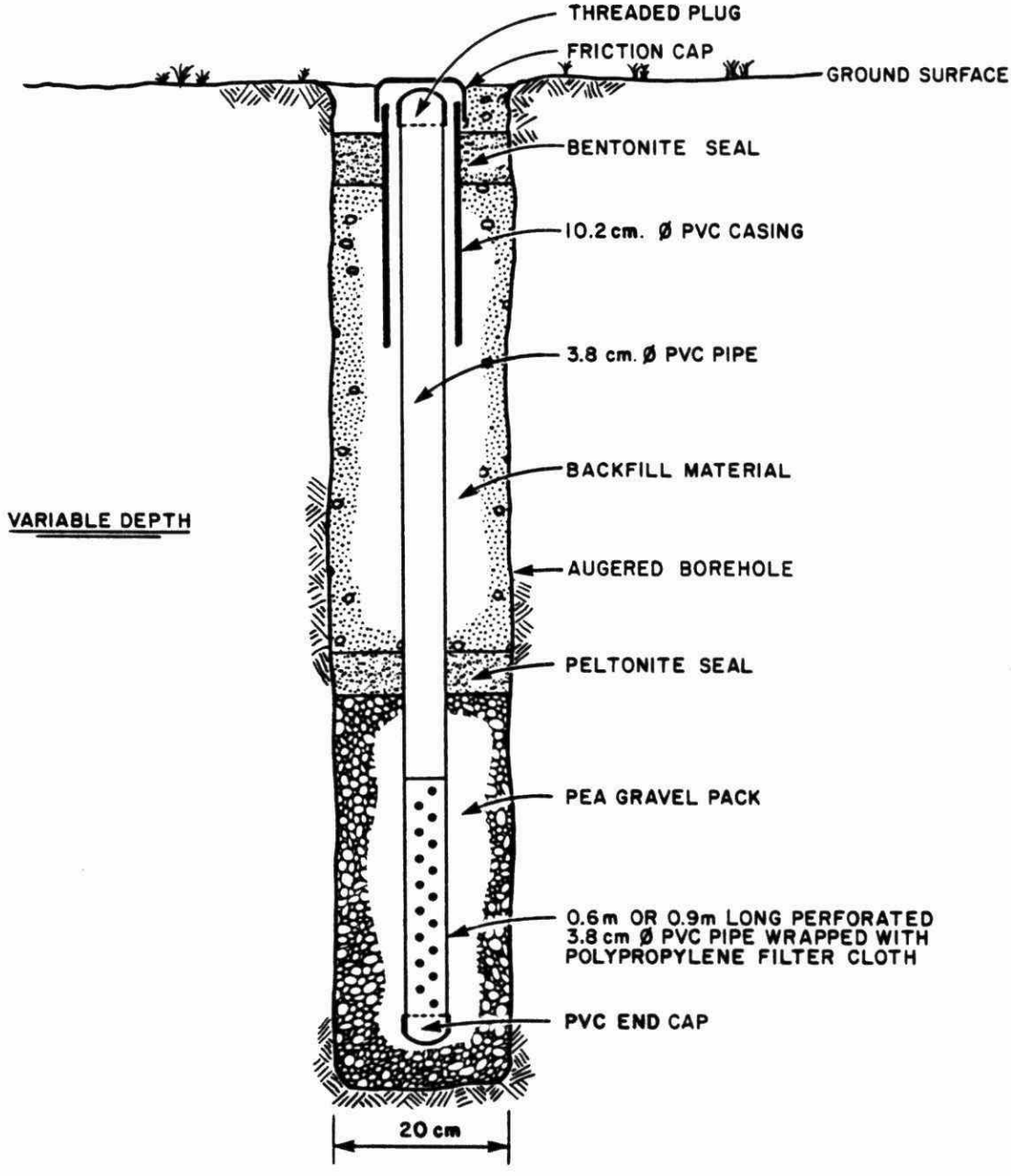


figure 2.3

TYPICAL OBSERVATION WELL DETAIL

Waste Site Identification Study

CRA

9-0913-18/08/82

for pH and conductivity. The purpose of the bailing was to purge the wells of the water which was encountered during the installation and allow for chemical equilibrium prior to sampling. Approximately two to four weeks after the installation of the wells, groundwater samples were obtained for chemical analysis. The groundwater samples were analysed for basic chemistry (calcium, magnesium, sodium, potassium, alkalinity, sulphate, chloride, hardness, pH, conductivity, iron), COD and phenols. The groundwater sampling was conducted a total of three times on approximately a four month schedule. Prior to sample collection groundwater levels were obtained and the wells bailed (at least one well volume).

b) All gas probes and gas monitoring locations were monitored for combustible gas using an explosion meter. The gas probes were monitored during each groundwater monitoring period and once each in the month of November, December, January, February, March and April.

6) After completion of the detailed site analysis, a comparison of the results from the detailed analysis to the preliminary analysis was

undertaken. This comparison reviewed such aspects as the defined extent of waste disposal, gas production and migration, leachate production and migration, and environmental impact.

7) The comparison of the preliminary study with the detailed study of the three sites in the West Central Region provided a basis for reviewing the validity of the preliminary study. Using this information, a review of the remainder of the sites within the West Central Region was conducted. It is to be noted that this review was only conducted through an evaluation of the information presented in the final report of the Phase II - Part I study.

GENIVAR ENGINEERS & ASSOCIATES LIMITED

3.0 SITE NO. 0044-THOROLD

3.1 BACKGROUND

Site No. 0044, the Battle of Beaverdams Park in Thorold, is located in Figure 3.1. This narrow park is a short section of the abandoned old Welland Canal and is adjacent to the commercial section of the City of Thorold.

Selected water well records on file with the Ministry of the Environment along with geological maps and reports for the Thorold area show the quaternary geology to be lacustrine sediments of interbedded clay, silt and sand overlying bedrock. These sediments are on the order of 7.5-11.0 meters thick in the vicinity of the site. The bedrock is dolomite from the Lockport-Amabel Formation. Figure 3.1 locates the selected waterwells and Table B-1 of Appendix B presents the water well logs.

Figure 3.2 locates the old Welland Canal channel on a map of the City of Thorold. The recent history of the old Welland Canal is summarized below.

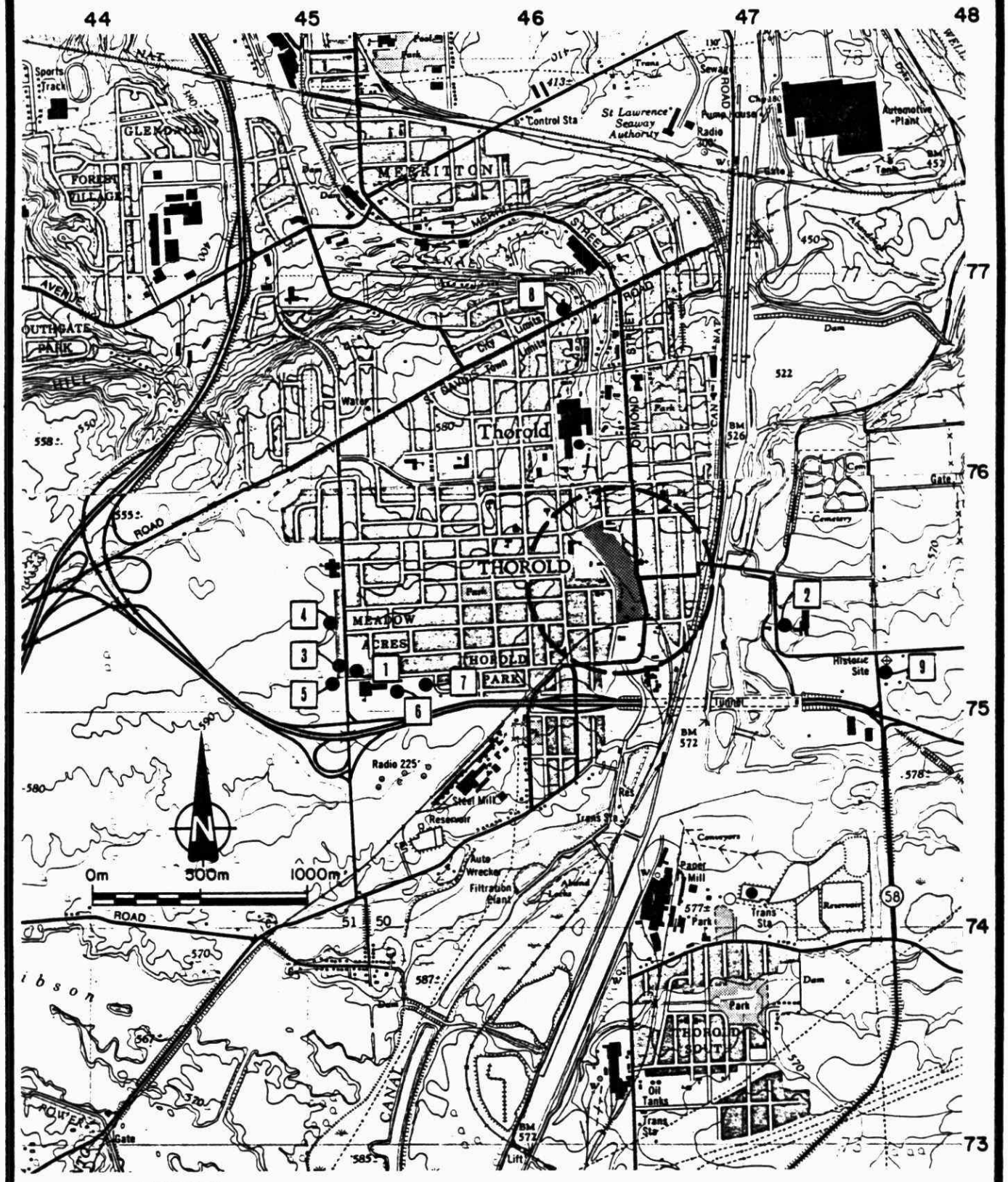
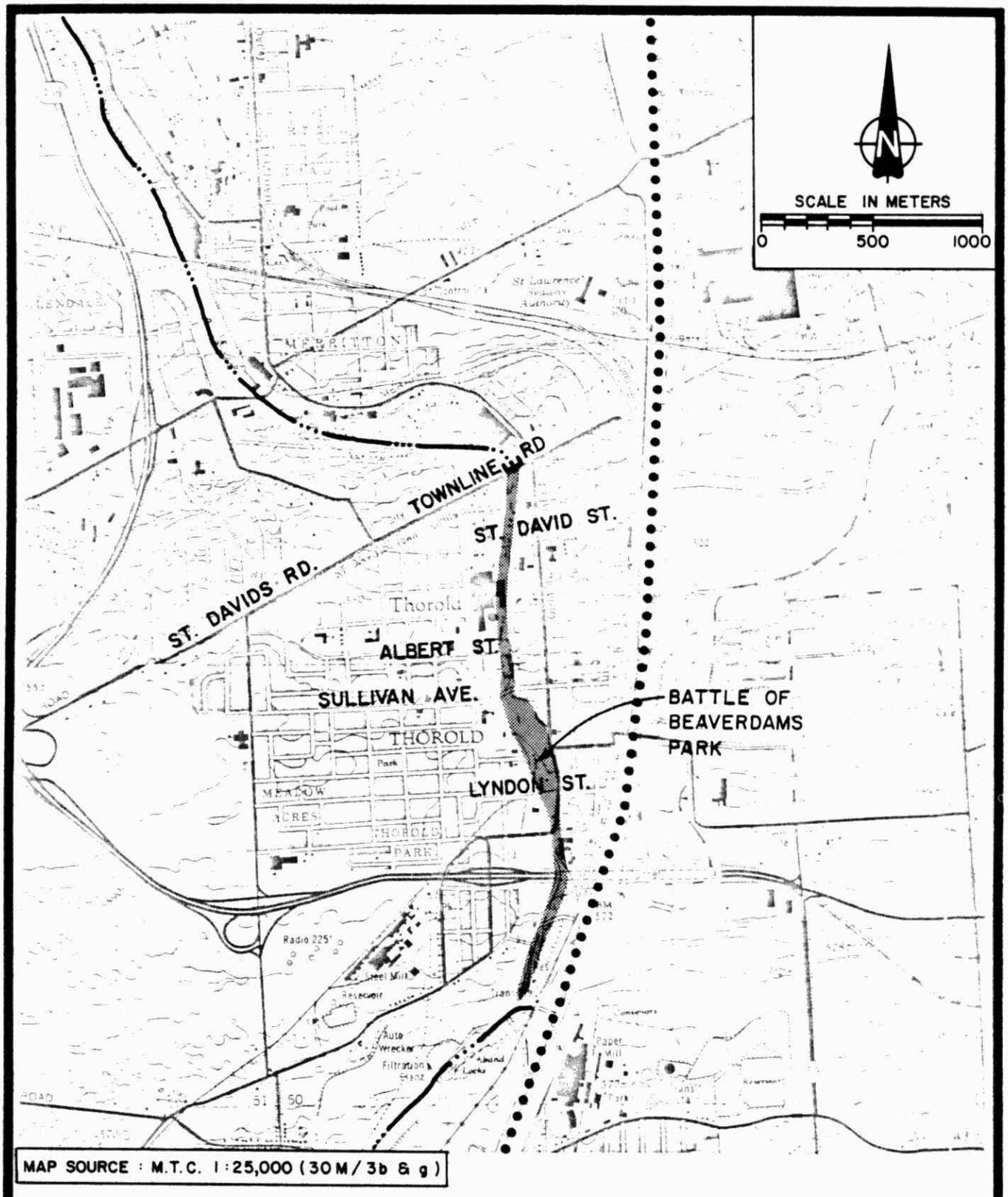


figure 3.1

LOCATION OF SITE Nº 0044
WASTE SITE IDENTIFICATION STUDY
Ministry of the Environment

CRA

9-0913



MAP SOURCE : M.T.C. 1:25,000 (30M/3b & g)

LEGEND

- OLD WELLAND CANAL — OPEN WATER
- NEW WELLAND CANAL
- OLD WELLAND CANAL —FILLED

figure 3.2

LOCATION OF OLD WELLAND CANAL

WASTE SITE IDENTIFICATION STUDY

Ministry of the Environment

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Up to 1959 the old Welland Canal was reported to be used to dispose of liquid waste from pulp and paper mills, raw sewage and storm runoff. The canal at this time flowed and discharged to Twelve Mile Creek approximately 6 kilometers northwest of where the canal intersects Townline Road. By 1960, a concrete box sewer was constructed along the base of the old canal through the City of Thorold. In the mid-1960's the canal was being filled from where it intersects the new Welland Canal south of Thorold northward to St. Davids Road, north of Thorold. From the intersection of the old and new Welland Canal to Lyndon Street, clean fill from the canal tunnel was deposited in the old canal. The Battle of Beaverdams Park extends from Lyndon Street to Sullivan Avenue. Refuse was deposited in this section of the canal from approximately 1964 to 1968. From Sullivan Avenue to Albert Street, the canal was filled with some refuse, but the quantity and location was unknown. Clean fill was reported to be deposited in the canal from Albert Street to St. David Street. Some refuse was also reported to be present in the section of the canal from St. David Street to Townline Road.

3.2 FIELD INVESTIGATON

The field investigation program entailed the use of the CME drill rig for installation of gas probes and observation wells. It was not practical to use the portable auger due to the very difficult drilling in upper cover soils. A backhoe was not used due to the park being a landscaped area. A truck-mounted CME drill rig was used on the site in September, 1981 to determine at-depth stratigraphy, obtain soil samples and install monitors.

A total of eight boreholes were augered at the site. The first four boreholes were augered along the length of the park and terminated between 8.2 meters and 11.0 meters below ground surface. One observation well and one gas probe was placed in each of these boreholes. Four more boreholes were drilled along the park boundary near buildings adjacent to the park to a depth of approximately 3 meters below ground surface. A gas monitoring probe was placed in each of these boreholes. The location of the gas probes and observation wells is shown on Map 3.1, an aerial photograph of the site. Table B-2 of Appendix B presents the Stratigraphic and Instrumentation Logs for the boreholes.

Typically the cover material is a grey fine sandy clay fill. The zone of refuse is significantly variable in a vertical cross-section. The layers that were sampled are described in the logs. The refuse can generally be divided into two classes: domestic and commercial/industrial. The domestic refuse contains paper, glass, metal fragments and plastic bags. The commercial/industrial refuse is represented primarily by wood fibre and wood chips, probably from one of the local pulp and paper industries.

The boreholes OW1-81 and OW2-81 met refusal in rock (suspected to be bedrock) at 7.5 meters and 9.6 meters below ground surface respectively. Observation well OW4-81 met refusal at 8.2 meters below ground surface on a log, suspected to be a wooden log associated with a railway trestle. Observation well OW3-81 terminated in a compact grey sandy silty clay till at 9.2 meters below ground surface, from which a soil sample was collected for analysis. The result of the grain size analysis of the till is presented in Figure 3.3. The permeability is estimated to be less than 3×10^{-7} cm/sec, as calculated by the Hazen method.

GRAIN SIZE DISTRIBUTION

THOROLD. 9-0913.

BH 3-81 10.4 -11.1 METRES

SAMPLE # 5

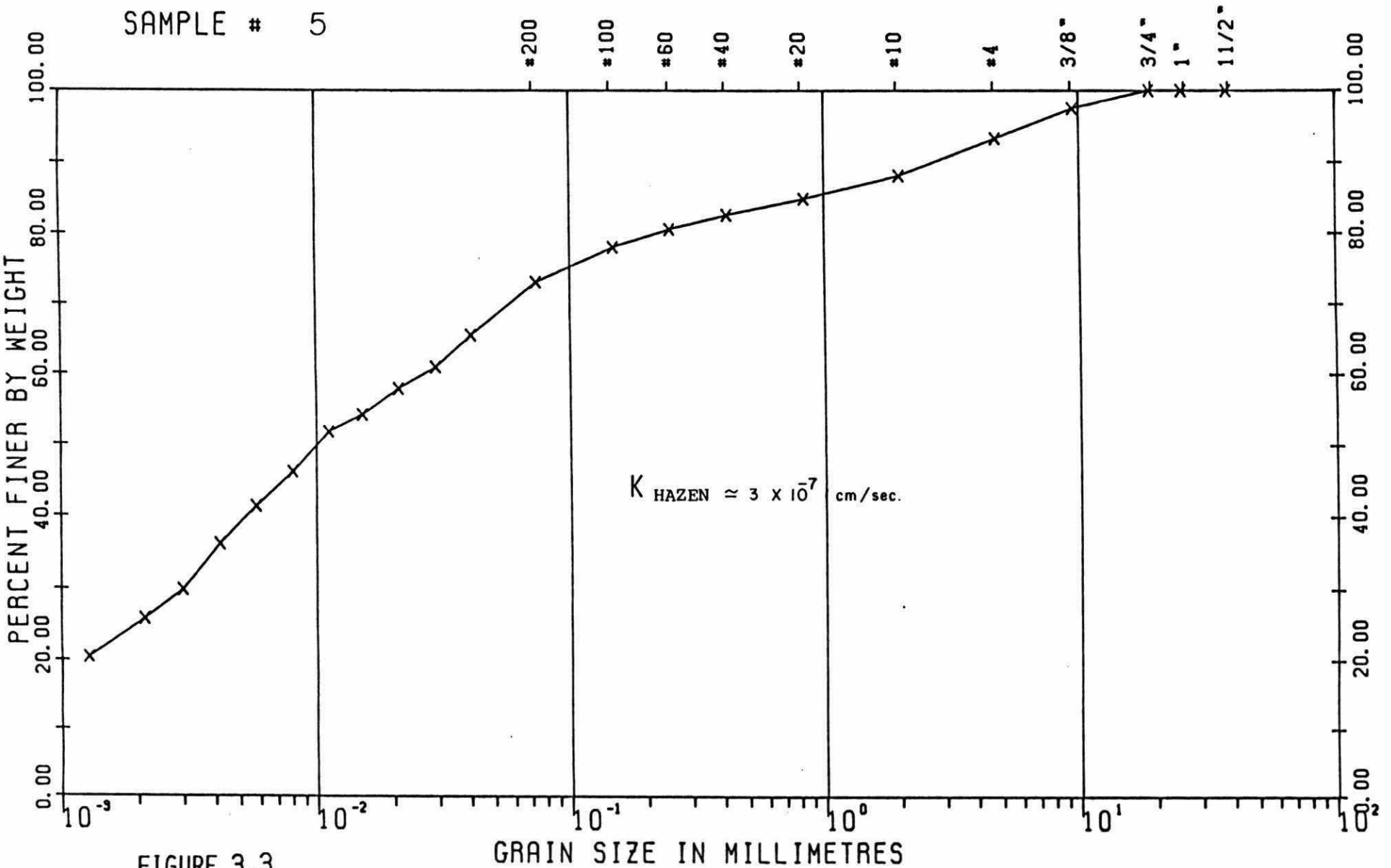


FIGURE 3.3

3.3 EXPANDED FIELD INVESTIGATION

On November 10, 1981 the first progress report for the Phase II - Part II study for the West Central Region was presented to the Ministry of the Environment. At that time, Conestoga-Rovers & Associates Limited indicated to the Ministry that the area suspected to be used for waste disposal was in fact much larger than anticipated and could encompass the complete filled in area of the old Welland Canal as defined on Figure 3.2.

The results from the gas monitoring at the Battle of Beaverdams Park indicated high levels of combustible gas (as will be described later) and therefore stress the importance of defining the total area of waste disposal. It was therefore decided to expand the area of investigation to the complete area filled within the old Welland Canal. Under the Phase II - Part I study, portions of this filled canal were in fact classified as three sites namely, Site 0042, Site 0043 and Site 0044. It was decided by the Study Committee that the original site (Site No. 0044) would be investigated comprehensively with the remainder of the filled canal being investigated using the preliminary (Phase II - Part I) methodology.

The expanded limit of investigation is shown in Figure 3.2. Areas along the total filled old Welland Canal that possibly contained putrescible materials were located with the information from personal interviews of local residents and municipal officials. The emphasis for the field investigation was placed on the soil identification and combustible gas monitoring at the foundations of buildings that were on or adjacent to the buried canal.

On November 18, 1981 a gas-powered portable auger with 5 cm diameter augers was used to drill an additional 17 boreholes (GMP9-81 to GMP25-81) along the canal to a maximum depth of 1.5 meters as located on Map 3.2. Boreholes were placed along the canal channel and at the foundation of buildings on or immediately adjacent to the canal. The description of fill encountered is presented in Table B-3 in Appendix B. The soils observed were generally a thin layer of topsoil underlain by silty clay. Four boreholes intersected materials that are associated with refuse. GMP10-81 encountered pieces of concrete, asphalt and gravel, while GMP14-81, GMP20-81 and GMP24-81 contained black sandy fill commonly associated with refuse deposits. No large fragments of putrescible refuse were observed in any of these boreholes.

A gas monitoring probe was installed in each borehole (GMP9-81 to GMP25-81). Each gas probe was 1.3 cm diameter PVC pipe with a screen 0.6 meters long of drilled pipe wrapped with polypropylene filter cloth. The borehole was backfilled with native material. The gas monitoring probe locations are presented on Map 3.1 and 3.2.

The total 25 gas monitoring probes and 4 observation wells have been monitored monthly since their installation for combustible gas and water levels respectively. The observation wells have also been sampled three times for water quality.

It should be noted that the City of Thorold was made aware of the initial site investigation and the expanded site investigation at this location. Independently the City of Thorold commissioned Conestoga-Rovers & Associates Limited to conduct a detailed site investigation of the complete canal along with the installation of further monitors within the site. This program is still on-going and is reported separately to the City of Thorold.

3.4 HYDROLOGY

The surface topography for the Battle of Beaverdams Park is gently sloping downwards toward the north as shown on Map 3.1. Surface water runoff generally flows northward, but only for a short distance before being directed into one of several catch basins.

The detailed study of the groundwater for the old Welland Canal was restricted to the Battle of Beaverdams Park. Groundwater levels in the Battle of Beaverdams Park were monitored by the four observation wells. These levels were measured once a month since September 1981, and the results are shown on Table 3.1. The largest water level fluctuation took place from October/November 1981 to February 1982 for OW1-81 ($\pm$2 m), OW2-81 ($\pm$1 m) and OW3-81 (0.2 m). OW1-81 is located on a small groundwater mound and therefore susceptible to the greatest variation in water levels. The water level in OW4-81 varied a maximum of 0.2 meters from February to April 1982. The direction of groundwater flow is reflected by the topography with an average horizontal gradient of 0.0045 meters per meter to the north along the length of the park. The only irregularities to this flow are caused by a small topographic mound at OW1-81 and the 3 meter depression at the historic lock.

TABLE 3.1

WATER LEVELS

MONITORING DATES
(Water Elevations in Meters AMSL)

Observation Well	Ground Elevation (m AMSL)	Sept. 15 1981	Oct. 27 1981	Nov. 17 1981	Dec. 15 1982	Jan. 14 1982	Feb. 11 1982	Mar. 19 1982	Apr. 16 1982	May 14 1982	June 22 1982
OW1-81	176.47	170.855	169.710	171.526	169.979	170.053	169.611	170.202	170.433	170.078	169.990
OW2-81	173.32	168.431	169.191	169.119	168.792	168.817	168.122	168.742	168.684	168.594	168.510
OW3-81	172.04	167.693	167.708	167.758	167.716	167.661	167.564	167.709	167.586	167.596	167.646
OW4-81	176.09	169.542	169.547	--	169.536	169.584	169.425	169.483	169.655	169.470	169.492

The screen for each of the observation wells was located in the refuse. Recovery tests were conducted on the observation wells to estimate the hydraulic conductivity (K) of the refuse. All four wells were tested and the data suggested that the wells were not fully developed which would result in a slightly higher estimate of K. The range of average values for K for each observation well is presented below:

OW1-81: $K = 3 \times 10^{-3}$ cm/sec.
OW2-81: $K = 5 \times 10^{-4}$ cm/sec.
OW3-81: $K = 6 \times 10^{-4}$ cm/sec.
OW4-81: $K = 2 \times 10^{-5}$ cm/sec.

3.5 WATER QUALITY

The four observation wells were sampled three times at approximately four month intervals. Each observation well was bailed for at least one well volume and then sampled and analysed for major ions, phenol, total iron and COD. Water samples were also collected at the intake to the box sewer (SP1-81) and at the discharge point of the sewer (SP2-81) to compare the water quality with the observation wells.

The water quality data is presented in Table 3.2. The water quality of samples, collected from the observation wells, showed significant improvement over the sampling period. This change can be attributed to the time required for the well chemistry to achieve equilibrium. Most chemical parameters showed a minor change between the February and June samples. It is expected that the observation wells are close chemical equilibrium.

Compared to typical landfill leachates, the chemistry of the most recent samples show relatively low concentrations. The conductivity values of 640 to 1,620 uS/cm are significantly below the expected range (8,000 - 60,000 uS/cm) of a well-defined leachate. The COD of <25 mg/L is well below the general range (1,000 - 90,000 mg/L) of landfill leachates suggesting that the chemical activity within the refuse is relatively low. The pH is slightly basic with the exception of OW4-81 at pH of 6.9. Hardness values varying from 299 to 860 mg/L are moderately high. The source of the high concentrations of dissolved Ca (81 to 216 mg/L) and Mg (24 to 78 mg/L) is not obvious, but may be intrinsic to the native till soils on the waste. The phenol results showed a considerable variation with time. Phenol concentrations, for all of the wells, were notable,

TABLE 3.2

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

THOROLD - SITE NO. 0044

PARAMETER	OW1-81			OW2-81		
	Sept.15, 1981	Feb. 11, 1982	June 22, 1982	Sept.15, 1981	Feb. 11, 1982	June 22, 1982
pH	8.0	7.1	7.3	8.0	7.1	7.8
Conductivity (uS/cm)	2,700.	2,000.	1,530.	850.	620.	640.
Hardness as $CaCO_3$	1,250.	1,000.	840.	331.	270.	299.
Calcium as Ca	328.	270.	211.	92.	78.	81.
Magnesium as Mg	105.	79.	76.	25.	19.	24.
Sodium as Na	96.0	54.0	40.	48.0	18.0	19.
Potassium as K	42.0	19.0	10.1	9.7	6.5	6.3
Alkalinity as $CaCO_3$	1,060.	1,190.	902.	189.	285.	290.
Sulphate as SO_4	210.	<1.	<1.	51.	5.	<1.
Chloride as Cl	200.	71.	60.	100.	38.	42.
Iron as Fe	1.2	1.6	0.6	<0.01	0.22	0.05
COD	260.	80.	<25.	227.	<25.	<25.
Phenols** (ug/L)	51.	63.	-	40.	3.	13.

Note:
1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services.

TABLE 3.2 (Cont'd)

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

THOROLD - SITE NO. 0044

PARAMETER	OW3-81			OW4-81		
	Sept.15, 1981	Feb. 11, 1982	June 22, 1982	Sept.15, 1981	Feb. 11, 1982	June 22, 1982
pH	7.5	7.3	7.7	7.5	6.7	6.9
Conductivity (uS/cm)	2,500.	1,620.	1,170.	2,000.	1,900.	1,620.
Hardness as $CaCO_3$	1,420.	800.	588.	1,020.	995.	860.
Calcium as Ca	360.	177.	109.	300.	244.	216.
Magnesium as Mg	126.	87.	77.	66.	94.	78.
Sodium as Na	131.0	40.0	40.0	84.0	42.0	48.0
Potassium as K	14.0	5.5	7.6	7.6	5.8	5.7
Alkalinity as $CaCO_3$	1,120.	639.	582.	1,020.	950.	820.
Sulphate as SO_4	170.	290.	62.	7.	<1.	<1.
Chloride as Cl	290.	89.	59.	159.	141.	128.
Iron as Fe	0.79	0.38	0.03	0.40	4.90	19.00
COD	153.	<25.	<25.	274.	<25.	<25.
Phenols** (ug/L)	10.	72.	1.	44.	28.	10.

Note: 1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services.

TABLE 3.2 (Cont'd)

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

THOROLD - SITE NO. 0044

PARAMETER	SP1-81			SP2-81		
	Sept.15, 1981	Feb. 11, 1982	June 22, 1982	Sept.15, 1981	Feb. 11, 1982	June 22, 1982
pH	8.1	*	8.1	7.2	*	6.9
Conductivity (uS/cm)	340.	*	280.	410.	*	400.
Hardness as $CaCO_3$	133.	*	128.	145.	*	132.
Calcium as Ca	40.	*	38.	50.	*	41.
Magnesium as Mg	8.	*	8.	5.	*	7.
Sodium as Na	9.8	*	8.1	33.0	*	29.0
Potassium as K	1.5	*	1.1	2.6	*	1.7
Alkalinity as $CaCO_3$	102.	*	95.	100.	*	85.
Sulphate as SO_4	27.	*	25.	86.	*	65.
Chloride as Cl	24.	*	21.	30.	*	30.
Iron as Fe	<0.01	*	0.08	0.07	*	0.01
COD	<25.	*	<25.	160.	*	118.
Phenols** (ug/L)	20.	*	1.0	6.	*	626.

* Frozen

Note: 1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services.

ranging from 1 to 13 ug/L for the June 22, 1983 samples. The phenol sample of June 22, 1982 for OW1-81 was broken in transit.

The general trend of aqueous species in the groundwater at the site is for increasing concentrations from the south to the north, which coincides with the flow direction. The values at OW2-81 are anomalously low but this may be the result of dilution from a groundwater mound extending westward from OW2-81.

There are no wells within 100 meters of the site and there are no open waterways or observed leachate springs on the site. Surface water samples were collected from the intake (SP1-81) and outflow (SP2-81) of the box sewer extending along to the base of the canal for the length of the City of Thorold. The water quality showed only minor fluctuation over time. The water quality is generally good with the exception of a moderately high phenol concentration of 20 ug/L in September 1981 for SP1-81, and a very high phenol concentration of 626 ug/L in June 1981 for SP2-81. The SP1-81 phenol concentration in June was 1 ug/L, so there appears that a significantly high concentration of phenols was introduced from the filled canal as discharge points into the box sewer at that time.

3.6 AREAS OF WASTE DISPOSAL

From the field investigation results and discussion with local residents, two areas of waste disposal along the old Welland Canal have been recognized. These areas are presented on Map 3.1 and 3.2. The first area extends from Lyndon Street northward to just past Albert Street. The type, quantity and areal extent of refuse between Sullivan Avenue and Albert Street is not well defined as detailed field investigation was not conducted in this area.

The second area of waste disposal is located between St. Davids Street and Townline Road. This area was also examined using preliminary techniques, including the examination of old maps and aerial photographs and the use of a portable power auger in the field, so the areal extent of refuse disposal and the waste characteristics are approximate.

The remainder of the old Welland Canal that has been buried, is believed to be filled with inert materials, usually rock and soil from construction excavations.

The study being conducted for the City of Thorold by Conestoga-Rovers & Associates Limited

examines in-depth the refuse extent and potential hazards.

3.7 LEACHATE PRODUCTION AND LOADING

The largest refuse deposit along the old Welland Canal is situated under and in close proximity to the Battle of Beaverdams Park. Refuse deposits have also been identified along the old canal between Sullivan Avenue and Albert Street and between St. Davids Street and Townline Road. These deposits are relatively small, and were not monitored for water quality. These smaller deposits are not expected to contribute significantly to the leachate production. The emphasis for the characteristics of the leachate was directed towards the refuse within the Battle of Beaverdams Park.

The Battle of Beaverdams Park covers an area of approximately 2615 m^2. This does not include the area around the lock which has been excavated. The mean annual precipitation for the City of Thorold is 83.8 cm. Infiltration is expected to be less than 10% of the precipitation due to the low permeability of the clay silt soils and a good surface drainage. Using a conservative estimate of 8.4 cm. for infiltration, the leachate production is calculated to be

approximately 220,000 L/year. The rate of leachate migration is considered low due to the low permeability of the native soils. The leachate migration would also be limited by the high attenuation capacity of the native soils. However, it should be noted that no downgradient off-site wells were installed to verify this. The relative loading on this site by the leachate was estimated by examining three chemical parameters (Cl, Fe, phenols). The concentrations for these parameters from June 22, 1982 were used to obtain loading rates of 0.044 kg/day for Cl, 0.003 kg/day for Fe (total) and 5×10^{-6} kg/day for phenols.

3.8 COMBUSTIBLE GAS MONITORING

Eight gas monitoring probes (GMP1-81 to GMP8-81) were installed in the Battle of Beaverdams Park as located on Map 3.1. Four probes are nested with the observation wells along the central axis of the park and four other gas probes are along the periphery of the park.

Seventeen additional gas monitoring probes (GMP9-81 to GMP25-81) were installed along the buried old Welland Canal through the City of Thorold. GMP9-81 and GMP10-81 were installed south of the Battle of Beaverdams Park along the section of the

canal where no refuse was reported. These two probes were placed to confirm this. GMP11-81 to GMP18-81 were installed outside the park and usually adjacent to the foundations of buildings to check the lateral migration of combustible gas from the park. GMP19-81 and GMP20-81 were placed adjacent to the Thorold Fire Hall near areas that were suspected of containing refuse. GMP21-81 to GMP24-81 were installed adjacent to building foundations that were near the old canal. Refuse was not reported in this area, so these probes were used to confirm this. GMP25-81 was placed near an area that was reported to contain refuse.

Table 3.3 presents the results of the gas monitoring conducted over the 10 month monitoring schedule. The first sampling period in September 15, 1981 showed no combustible gas at any of the probes whereas the second sampling period in October 27, 1981 indicated high proportions of combustible gas detected in all of the probes. The disparity between the results of the two sampling periods is difficult to explain. The first sampling period may have been too soon after monitor installation for gas to equilibrate, but is considered anomalous in any event.

Combustible gas readings were monitored again in the gas probes on November 5, 1981.

TABLE 3.3

COMBUSTIBLE GAS LEVELS

MONITORING DATES
(% Volume Methane)

Monitor	Sept. 15 1981	Oct. 27 1981	Nov. 5 1981	Nov. 17 1981	Dec. 15 1981	Jan. 14 1982	Feb. 11 1982	Mar. 19 1982	Apr. 18 1982	Apr. 29 1982	June 22 1982
GMP1-81	0	65	68	77	77	74	49	*	61	32	57
GMP2-81	0	55	55	75	70	70	23	40	55	44	54
GMP3-81	0	72	68	84	77	65	67	65	88	36	60
GMP4-81	0	38	32	43	54	48	33	8	17	16	31
GMP5-81	0	65	60	74	54	52	33	13	41	27	34
GMP6-81	0	65	70	78	69	63	60	44	76	55	57
GMP7-81	0	55	30	51	70	36	24	*	85	53	55
GMP8-81	0	72	65	71	38	63	13	*	37	11	9
GMP9-81					0	0	0	0	0	0	0
GMP10-81					0	0	0	0	0	0	0
GMP11-81					0	0	0	0	0	0	0
GMP12-81					0	0	0	*	0	0	0
GMP13-81					0	0	0	0	0	0	0
GMP14-81					0	0	0	1.5	0	1	1
GMP15-81					0	0	0	0	0	0	0
GMP16-81					0	0	0	0	0	0	0
GMP17-81					0	0	0	0	0	0	0
GMP18-81					0	0	0	*	0	0	0
GMP19-81					0	0	0	0	0	0	0
GMP20-81					0	0	0	*	0	0	0
GMP21-81					0	0	0	0	0	0	0
GMP22-81					0	D	D	D	D	D	D
GMP23-81					0	0	0	*	0	0	0
GMP24-81					0	0	0	-	0	0	0
GMP25-81					0	0	0	0	0	0	0

D - Destroyed

* Water in Probe

In addition, gas samples were collected in duplicate at two probes and analysed in the Conestoga-Rovers & Associates Limited laboratory to confirm the field results. The results of this comprehensive analysis is presented on Table 3.4. As can be seen in Table 3.4, the elevated methane levels were in general verified by the comprehensive gas analysis.

The presence of combustible gas was monitored in the top of manholes and catch basins along the park, and in the gas vents around the Thorold Community Credit Union building. Combustible gas was not detected at any of these locations.

3.9 COMBUSTIBLE GAS GENERATION

For the purposes of determining the quality of combustible landfill gas being generated at the Battle of Beaverdams Park, it is necessary to utilize literature values for gas production and then amend these values for the type of waste encountered at the site. An average of gas production of 0.015 kg/m^3 of wet refuse per year was utilized. The combustible gas portion of the landfill gas was assumed to comprise approximately 50% of the total landfill gas.

TABLE 3.4

COMPREHENSIVE GAS ANALYSIS

SAMPLED NOVEMBER 5, 1981

Sampling Location	Concentration (% by Vol.)							CH_4 Field Measurement
	CO_2	H_2	O_2	N_2	CH_4	CO	Other	
GMP3-81	28	--	1.0	5	61	--	<5	68
GMP3-81	29	--	0.9	4.3	61	--	<5	68
GMP2-81	23	--	7	33	37	--	<1	55*
GMP2-81	20	--	9	38	32	--	<1	55*

* During actual sample collection, CH_4 measured about 40%.

At the Battle of Beaverdams Park Site, assuming a density of refuse of 590 kg/m^3, the volume of refuse was calculated at 128,000 m^3 of which it is estimated 20% to 30% of this refuse is putrescible.

Using the above parameters, it is calculated that the annual volume of methane generated is expected to range from 115,000 to 173,000 cubic meters per year.

3.10 SUMMARY

The following summarizes the findings of the detailed investigation at the Battle of Beaverdams Park Site (0044):

1) The areal extent of the refuse is approximately 2,600 m^2 with the thickness of refuse ranging from <1 to 9.5 meters.

2) The type of waste is generally of domestic origin with significant quantities of wood (chips and larger fragments) and paper, probably from a local pulp and paper manufacturer. The age of the waste varies from about 14 to 18 years. Refuse located

in the saturated zone is only partially decomposed.

3) The concentration of most chemical parameters in the leachate is relatively low as compared to typical leachate. The concentrations of calcium, magnesium and hardness are elevated, but considered representative of the groundwater in the Thorold area.

4) Groundwater flow appears to be generally northward with an average gradient of 0.0045. The permeability of the till underlying the refuse is on the order of 10^{-7} cm/s, whereas the hydraulic conductivities of the refuse range from 3×10^{-3} to 2×10^{-5} cm/s.

5) Leachate migration is northward, but the rate of attenuation is anticipated to be high, however this was not verified in this study.

6) The low concentrations of chemical parameters in the leachate suggests that there is presently no significant hazard from leachate migration. There is a high concentration of phenols at the discharge point for the box culvert, but there is no specific evidence that suggests that these phenols derive from the landfill deposit.

7) The rate of combustible gas generation is expected to be relatively low due to the age of the refuse and the high water table. Relatively high concentrations of combustible gas have been detected at several locations within the Battle of Beaverdams Park. The gas monitoring probes at these locations have been placed in relatively deep boreholes. The gas probes outside the park did not detect combustible gas, except minor quantities at GMP14-81. These probes are located in shallow small diameter holes.

8) Combustible gas migration is expected to be limited due to the fine grained soils and the relatively high water table.

9) The presence of combustible gas may present a hazard to those buildings located on or immediately adjacent to the Battle of Beaverdams Park.

10) Surface water flow is directed to storm drains located on and around the site.

11) There appears to be no significant existing or potential hazard due to leachate discharge to surface water courses.

12) Site development control at the park is necessary to prevent further development over the disposed waste.

The following summarizes the findings for the Welland Canal excluding the Battle of Beaverdams Park.

1) The approximate extent of refuse disposal is located in the vicinity of the Thorold Fire Hall and C.V.L. Industries Limited.

2) Combustible gas monitoring at the 17 installed gas probes indicated no measurable levels of combustible gas.

3) It is suspected that putrescible materials have been disposed of in portions of this canal and hence, there is a significant possibility for the generation of combustible gas.

4) A detailed site investigation should be undertaken for the remainder of the canal, with particular emphasis being placed upon landfill gas production and migration.

5) The foundations of buildings on or near the canal should be monitored for the presence of combustible gas.

6) If combustible gas is encountered at or near the foundations of the buildings, a remedial program should be undertaken to rectify the situation.

3.11 RESULTS OF SITE INVESTIGATIONS, PHASE II - PART I

In the Phase II - Part I of the Battle of Beaverdams Park (Site 0044), four shallow auger holes to a maximum of 1.68 meters were drilled along the length of the park. The refuse encountered was fragments of brick, glass, charcoal and plastic in a soil matrix. No combustible gas was detected in any of these auger holes, or in any of the buildings tested adjacent to the park, including the bandshell. Combustible gas was detected at 2% in one of the passive vents near the Thorold Community Credit Union. No water samples were collected. The report for this site concluded that detailed subsurface investigations should be conducted at all structures on or near the site, and that remedial measures be implemented depending on the investigation results. Table B-4 in Appendix B presents the Phase II - Part I report for Site 0044.

In the Site Investigations, Phase II - Part I, Site 0042 corresponds to a section of the old Welland Canal near Canadian Vapotred (CVL Rubber Industries), and Site 0043 corresponds to the buried canal at the Thorold Fire Hall.

At Site 0042, three auger holes were drilled to a maximum of 1.53 meters. No refuse was recorded at the auger hole near Townline Road, but a trace amount of combustible gas was detected. The second auger hole contained a trace amount of refuse and the third auger hole encountered cinders and broken glass. Combustible gas was not detected in any of the buildings sampled adjacent to the canal. No water samples were collected. The report recommends that gas monitoring be initiated, particularly at the Canadian Vapotred building. Table B-4 in Appendix B presents the Phase II - Part I report for Site 0042.

At Site 0043, two auger holes, drilled to a maximum of 0.92 meters in the buried canal, encountered brick, cinder and broken glass in a soil matrix. No gas was detected in these holes, or in the buildings tested along the canal, including the Fire Station. No water samples were collected. The report recommended that the Fire Station and the buildings

along Towpath Street be monitored for combustible gas during the winter months. Table B-4 in Appendix B presents the Phase II - Part I report for the Site 0043.

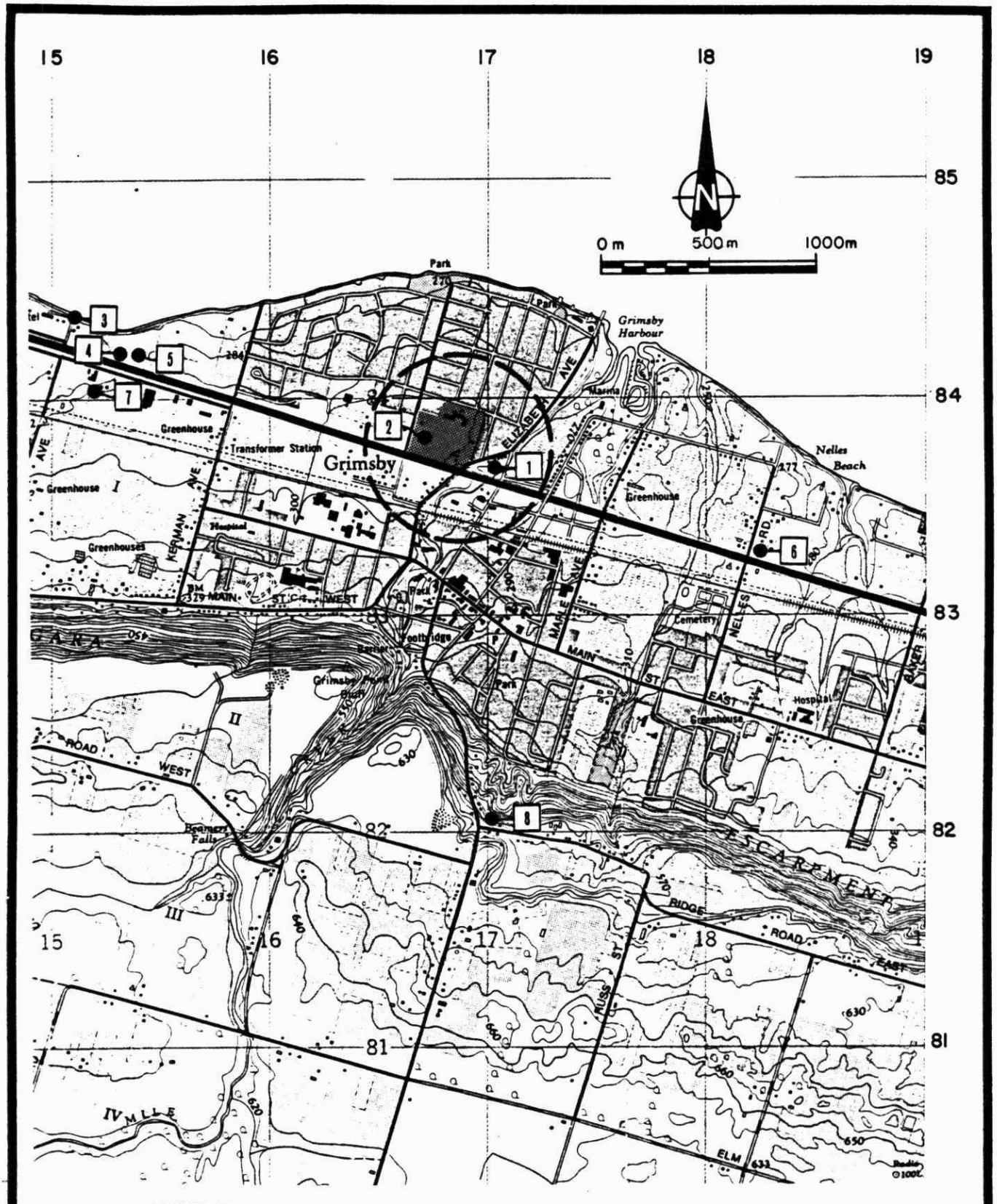
4.0 SITE NO. 0062-GRIMSBY

4.1 BACKGROUND

Site No. 0062 is the grounds of Lakeview Public School in Grimsby as located in Figure 4.1.

Water well records on file with the Ministry of the Environment indicate the general depth to groundwater for the area and general overburden/bedrock characteristics. These records are presented in Appendix C. As can be seen from the well records bedrock is encountered at or near the surface local to the site. The static water level is on the order of six meters below ground surface. Geological maps and reports for the Grimsby area show Queenston shale at or near the ground surface, and often very weathered for the top several meters.

An interview with the Director of Public Works for the City of Grimsby suggested that refuse has never been deposited on the grounds of the public school. In the past it had been suspected by others that this site had been used for cannery wastes. An interview with a representative of the school board indicated that he had no knowledge of any waste being disposed of at this location.



LEGEND

▩ — SITE LOCATIONS

[2] — PRIVATE WATER WELL (MOE RECORD)

figure 4.1

LOCATION OF SITE Nº 0062

WASTE SITE IDENTIFICATION STUDY

Ministry of the Environment

CRA

9-0913-18/08/82

4.2 FIELD INVESTIGATION

Three boreholes were drilled on the site in August, 1981. The location of the boreholes is shown on Map 4.1 an aerial photograph of the site. The Stratigraphic and Instrumentation Logs are presented in Appendix C.

Undisturbed Queenston shale was encountered only a few centimeters below ground surface. Topography and vegetation cover at the site suggest that the native material has never been disturbed below ground surface.

Further soil sampling and monitoring was discontinued due to refuse being detected.

4.3 SUMMARY

Refuse has not been observed on the site in either of the two phases of the Waste Site Identification Study. Also there are no records of refuse being deposited on or near the grounds of the Lakeview Public School. Therefore it is concluded that further investigation of this site is unnecessary.

4.4 RESULTS OF SITE INVESTIGATIONS, PHASE II - PART I

In the Site Investigations for Site 0062, seven auger holes were drilled to a maximum of 1.22 meters. No refuse was encountered and the material below the topsoil was described as a red brown silt, usually with shale fragments. No combustible gas was detected on the site. The report recommended that the school building be monitored for gas during the winter months, implementing remedial action if necessary.

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5.0 SITE NO. 0084-WATERLOO

5.1 BACKGROUND

Site No. 0084 is located along a section of the Laurel Creek, intersecting University Avenue and the Conestoga Expressway, in the City of Waterloo, as shown in Figure 5.1.

Geological maps and reports for the area show the quaternary geology to be highly variable. Water well records on file with the Ministry of the Environment as presented in Table D-1 of Appendix D, show the water levels and general statigraphy for the area. The water well locations are shown on Figure 5.1. The channel for Laurel Creek is composed of recent and modern alluvium, but this flow path was also part of an ancient glacial outwash channel. Outwash gravel and kame gravel or sand are found adjacent to the Laurel Creek flood plain. Till frequently underlies these deposits.

It is reported that from 1949/50 to 1957 refuse was deposited along Laurel Creek immediately south of the Waterloo Sewage Treatment Plant to an area that is now covered by the Conestoga Expressway. From 1957 to 1964, landfill operations

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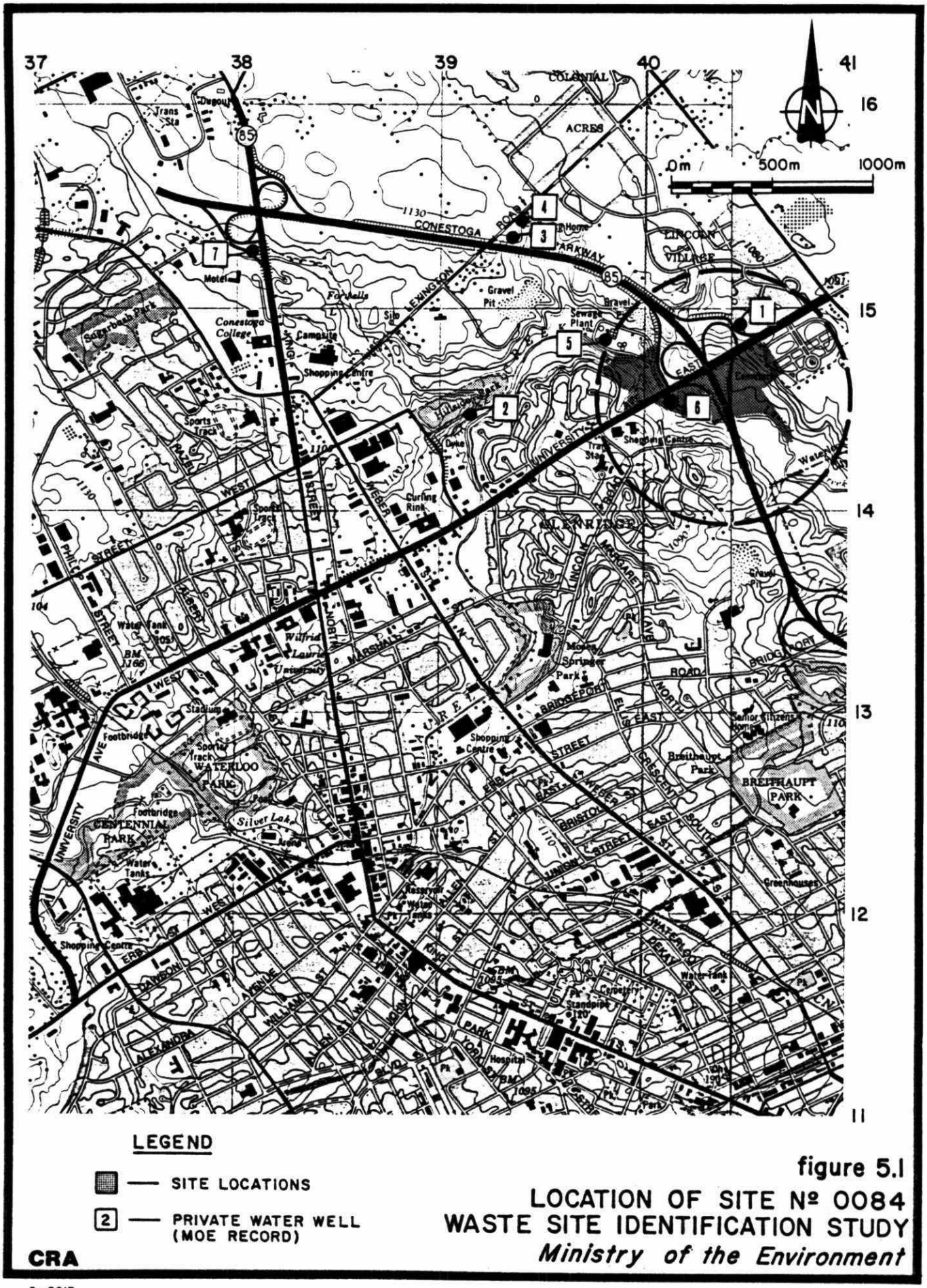

LEGEND

— SITE LOCATIONS

2 — PRIVATE WATER WELL (MOE RECORD)

CRA

figure 5.1

LOCATION OF SITE Nº 0084

WASTE SITE IDENTIFICATION STUDY

Ministry of the Environment

9-0913

CONESTOGA-ROVERS & ASSOCIATES LIMITED

continued at the west side of an area of land that is now the Parkview Cemetery and along Laurel Creek through the western half of Bechtel Park.

5.2 FIELD INVESTIGATION

Map 5.1 presents an aerial photograph of the study site. A portable motorized auger was used on August 20, 1981 to examine the unconsolidated material up to 2 meters below ground surface at various locations on the site north of University Avenue and the City of Waterloo property. The land is part of the present City of Waterloo sewage treatment plant operated by the Ministry of the Environment. Two gas probes were installed and later designated as GMP13-81 and GMP14-81, as located on Map 5.1.

On August 24, 1981, a backhoe was used to excavate 13 testholes on the City of Waterloo property north of University Avenue and on the property of the Waterloo Sewage Treatment Plant. The refuse location was delineated and soil samples were collected. Gas monitoring probes and/or observation wells were installed in most of the testholes. The monitors, stratigraphy and refuse are described in

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Table D-2 of Appendix D. The location of the monitors is presented on Map 5.1.

On September 1, 1981 drilling was conducted at the site using a truck-mounted CME drill rig with a 20 cm hollow-stem auger. Three boreholes were placed south of University Avenue next to the Parkview Cemetery and Bechtel Park near Laurel Creek. A gas probe was installed in each of these holes and two holes also contained an observation well. The fourth borehole was placed near the testholes and away from the refuse deposit north of University Avenue. At this borehole, an observation well was placed to monitor background groundwater levels and chemistry. The Stratigraphic and Instrumentation Logs for each of these holes are shown in Table D-2 of Appendix D, and the monitor locations are presented on Map 5.1.

The cover material for the buried refuse is a grey pebbly silty fine sand fill, sometimes containing minor amounts of glass and metal fragments. Typically the cover is at least 0.9 to 1.8 meters thick, but was only 0.5 meters at OW6-81. The refuse layer is predominately composed of domestic wastes but can also contain wooden logs, concrete fragments or rubber tires. The refuse in TH6-81 is mostly wastes from light construction, such as bricks and tar paper.

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The matrix of the refuse layer is typically a black sand.

Often a thin coarse gravel bed was found at the base of the refuse layer. Below the gravel a grey pebbly silty fine sand was encountered, from which a soil sample was collected for analysis. Figure 5.2 presents the grain size analysis indicating a silty fine sand till. The permeability of this soil is estimated to be 3×10^{-6} cm/sec using the Hazen method.

All holes containing standpipes were terminated below the refuse layer and below the water table. Holes where no refuse was observed but were located near refuse were, in general, installed with gas probes to monitor combustible gas migration.

5.3 HYDROLOGY

The site is contained along a section of the Laurel Creek river valley. Surface water flow is directed to Laurel Creek via tributaries and surface runoff. A small pond located within the boundaries of the Waterloo Sewage Treatment Plant is the only other major surface water source on the site.

GRAIN SIZE DISTRIBUTION

WATERLOO (0084). 9-0913.

TH2-81 4.6 METRES

SAMPLE # 2

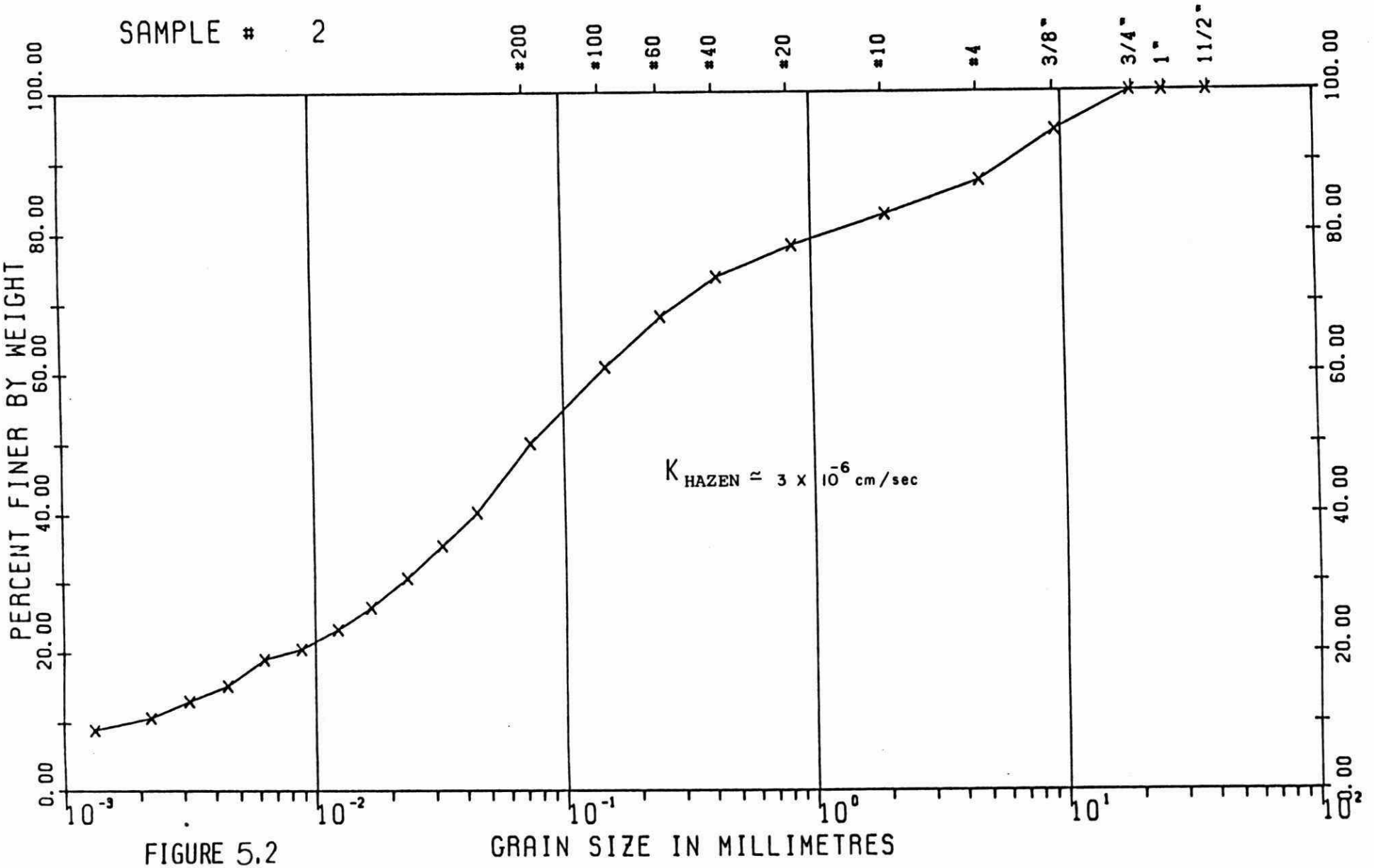

FIGURE 5.2

A small leachate spring is situated in a swale on the slope west of the Parkview Cemetery, as located on Map 5.1.

Water levels in the observation wells (OW1-81 to OW9-81) have been monitored 9 times during monthly sampling periods. The water level in the pond near the Waterloo Sewage Treatment Plant was also recorded. The results are presented in Table 5.1. In the observation wells, water levels varied by as much as 1.5 meters with the average variation of 0.6 meters. The lowest water levels were generally in February and March, 1982 with the highest levels occurring in April, 1982. The horizontal gradient of the groundwater was highly variable as a result of the variable topography. The maximum horizontal gradient was calculated to be 0.013 at OW6-81; the minimum gradient was 0.00081 at OW2-81; and the average gradient was calculated from OW2-81 to OW6-81 to be 0.0054.

Recovery tests were performed on selected observation wells, however the only reliable results came from the tests on OW3-81 and OW9-81. The screen for OW3-81 is located in refuse at the top and coarse gravel at the bottom. The average hydraulic

TABLE 5.1

WATER LEVELS

MONITORING DATES
(Water Elevations in Meters AMSL)

Observation Well	Ground Elevation (m AMSL)	Oct. 5 1981	Nov. 7 1981	Dec. 8 1981	Jan. 8 1982	Feb. 2 1982	Mar. 4 1982	Apr. 8 1982	May 7 1982	June 7 1982
OW1-81	312.64	309.766	309.834	309.786	309.706	309.598	310.604	-------	309.794	309.725
OW2-81	314.22	311.012	311.256	311.224	311.091	310.912	310.944	311.509	311.276	311.113
OW3-81	313.62	311.669	311.779	311.743	311.698	311.535	311.543	312.060	311.772	311.750
OW4-81	315.13	312.236	312.393	312.353	312.277	312.107	312.040	312.642	312.426	312.275
OW5-81	315.30	313.310	313.439	313.353	313.409	313.268	313.211	313.673	313.433	313.352
OW6-81	315.50	314.017	314.099	314.094	314.078	313.963	313.973	315.482	314.125	314.106
OW7-81	310.15	308.439	308.627	308.625	308.620	308.550	308.510	309.322	308.901	308.786
OW8-81	325.98	323.400	323.132	323.230	323.218	323.118	323.052	323.033	323.230	323.120
OW9-81	317.10	313.195	313.506	313.599	313.862	313.061	313.031	313.624	313.353	313.219
SP3-81	--	312.711	312.870	312.844	Frozen	Frozen	Frozen	Frozen	312.888	312.985

conductivity (K) was estimated to be 7×10^{-4} cm/sec. The screen for OW9-81 is located in compact grey sandy silt till. The average hydraulic conductivity was estimated to be 8×10^{-4} cm/sec.

Using the nested gas probe and observation well, at OW1-81, OW4-81, and OW6-81 the vertical gradient for the groundwater was estimated. The vertical gradient was negligible at OW1-81 and OW6-81, and approximately a downward gradient of 0.036 at OW4-81.

5.4 WATER QUALITY

A total of nine observation wells have been installed at the site which can be used for the collection of water samples. Each observation well was bailed for at least one well volume and then sampled and analysed for major ions, phenol, total iron and COD.

Water samples were also collected from upstream (SP1-81) and downstream (SP2-81) of Laurel Creek, the pond (SP3-81) near the Waterloo Sewage Treatment Plant and the leachate spring (SP4-81).

The water quality data is presented in Table 5.2. As can be seen from Table 5.2, variable levels of contamination are shown throughout the site. All of the wells showed a general improvement of water quality with time. Samples for all of the wells appear to be at or near chemical equilibrium in June 1982.

Observation well OW9-81 was placed in compact grey sand silt till up-gradient from the refuse deposit. The quality of water in this well is believed to represent background conditions. The concentrations of calcium (110 mg/L), magnesium (58 mg/L) and alkalinity (310 mg/L) are relatively high, which are related to the high values for hardness and conductivity. These are typical concentrations for the groundwater found in this area. Sulphate concentrations (230 mg/L) have remained anomalously high. The remaining chemical parameters, including phenols, are within acceptable limits.

Water quality in observation wells OW1-81 to OW7-81 in June 1982, indicates only minor groundwater contamination of major chemical parameters. The range of values for the major parameters is Ca to 132 to 208 mg/L, Na at 13 to 227 mg/L, K at 1.7 to 88 mg/L, SO_4 at <1 to 190 mg/L, Cl at 30 to 536 mg/L,

TABLE 5.2

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

WATERLOO - SITE NO. 0084

PARAMETER	OW1-81			OW2-81		
	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982
pH	7.0	7.0	7.2	7.8	7.5	7.5
Conductivity (uS/cm)	2,500.	1,950.	2,300.	2,500.	2,500.	2,300.
Hardness as $CaCO_3$	705.	582.	640.	1,040.	945.	948.
Calcium as Ca	220.	160.	200.	280.	200.	196.
Magnesium as Mg	38.	44.	34.	83.	108.	112.
Sodium as Na	213.	154.	227.	117.	85.	88.
Potassium as K	17.	15.	12.1	46.	43.	33.
Alkalinity as $CaCO_3$	635.	640.	671.	1,150.	1,130.	1,210.
Sulphate as SO_4	18.	<1.	3.	255.	4.	<1.
Chloride as Cl	475.	319.	536.	140.	125.	128.
Iron as Fe	11.5	18.	22.	2.7	0.36	1.06
COD	75.	60.	58.	200.	285.	130.
Phenols** (ug/L)	40.	12.	15/14.	22.	14.	10.

Note: 1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analysis conducted by Beak Analytical Services

TABLE 5.2 (Cont'd)

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

WATERLOO - SITE NO. 0084

PARAMETER	OW3-81			OW4-81		
	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982
pH	7.3	7.4	7.7	7.3	7.4	7.6
Conductivity (uS/cm)	1,690.	1,720.	1,910.	2,300.	1,920.	1,780.
Hardness as $CaCO_3$	669.	700.	740.	1,155.	945.	846.
Calcium as Ca	236.	220.	208.	368.	242.	206.
Magnesium as Mg	19.	36.	54.	40.	83.	79.
Sodium as Na	91.	76.	113	79.	50.	50.
Potassium as K	15.	16.	16	27.	27.	25.
Alkalinity as $CaCO_3$	700.	750.	649.	670.	705.	750.
Sulphate as SO_4	65.	2.	<1.	580.	310.	190.
Chloride as Cl	178.	160.	300.	128.	101.	91.
Iron as Fe	0.51	0.20	0.17	0.97	0.40	0.04
COD	200.	54.	43.	115.	54.	39.
Phenols** (ug/L)	9.	4.	6.	4.	8.	2.

Note:
1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services

TABLE 5.2 (Cont'd)

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

WATERLOO - SITE NO. 0084

PARAMETER	OW5-81			OW6-81		
	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982
pH	7.2	7.3	7.5	7.4	7.4	7.7
Conductivity (uS/cm)	1,150.	970.	1,010.	1,290.	1,020.	950.
Hardness as $CaCO_3$	585.	540.	533.	642.	519.	409.
Calcium as Ca	168.	164.	152.	194.	156.	122.
Magnesium as Mg	40.	32.	37.	63.	31.	25.
Sodium as Na	28.	29.	30.	48.	42.	46.3
Potassium as K	8.6	3.7	2.8	3.9	1.4	1.7
Alkalinity as $CaCO_3$	570.	530.	525.	420.	315.	359.
Sulphate as SO_4	45.	39.	50.	260.	145.	60.
Chloride as Cl	40.	46.	35.	80.	101.	79.
Iron as Fe	0.63	2.1	0.11	0.68	0.18	0.02
COD	190.	<25.	<25.	205.	<25.	<25.
Phenols** (ug/L)	37.	4.	<1/1.	8.	4.	<1.

Note: 1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services.

TABLE 5.2 (Cont'd)

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

WATERLOO - SITE NO. 0084

PARAMETER	OW7-81			OW8-81		
	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982
pH	7.2	7.2	7.6	7.6	7.7	8.0
Conductivity (uS/cm)	1,010.	870.	830.	6,800.	6,900.	6,400.
Hardness as $CaCO_3$	520.	481.	429.	960.	858.	760.
Calcium as Ca	138.	137.	132.	118.	105.	68.
Magnesium as Mg	43.	34.	24.	162.	145.	144.
Sodium as Na	19.	15.	13.	730.	500.	503.
Potassium as K	6.7	5.0	9.4	85.	87.	88.
Alkalinity as $CaCO_3$	490.	478.	428.	2,920.	3,050.	2,850.
Sulphate as SO_4	25.	24.	26.	<1.	4.	<1.
Chloride as Cl	44.	42.	30.	850.	850.	705.
Iron as Fe	0.10	0.68	0.04	0.20	0.53	0.38
COD	60.	42.	37.	675.	635.	631.
Phenols** (ug/L)	21.	5.	9.	ND	19.	127.

Note: 1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services.

TABLE 5.2 (Cont'd)

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

WATERLOO - SITE NO. 0084

PARAMETER	OW9-81		
	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982
pH	7.9	7.6	7.8
Conductivity (uS/cm)	1,150.	930.	990.
Hardness as $CaCO_3$	520.	443.	512.
Calcium as Ca	118.	104.	110.
Magnesium as Mg	55.	45.	58.
Sodium as Na	48.	35.	31.
Potassium as K	7.8	5.8	5.4
Alkalinity as $CaCO_3$	212.	241.	301.
Sulphate as SO_4	240.	250.	230.
Chloride as Cl	70.	15.	9.
Iron as Fe	<0.01	0.02	0.09
COD	75.	25.	<25.
Phenols** (ug/L)	7.	4.	1.

Note:
1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services.

TABLE 5.2 (Cont'd)

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

WATERLOO - SITE NO. 0084

PARAMETER	SP1-81			SP2-81		
	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982	Oct. 5, 1981	Feb. 2, 1982	June 7, 1092
pH	8.3	*	8.1	8.2	*	8.1
Conductivity (uS/cm)	1,060.	*	530.	1,010.	*	590.
Hardness as $CaCO_3$	336.	*	230.	320.	*	250.
Calcium as Ca	96.	*	64.	89.	*	72.
Magnesium as Mg	23.	*	17.	24.	*	17.
Sodium as Na	73.	*	24.	26.	*	27.
Potassium as K	9.	*	1.9	2.3	*	2.1
Alkalinity as $CaCO_3$	220.	*	178.	238.	*	193.
Sulphate as SO_4	80.	*	35.	0.75	*	46.
Chloride as Cl	74.	*	53.	60.	*	60.
Iron as Fe	0.11	*	0.05	0.01	*	<0.01
COD	<25.	*	<25.	<25.	*	27.
Phenols** (ug/L)	4.	*	3.	4.	*	1.

* Frozen

Note: 1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services.

TABLE 5.2 (Cont'd)

WATER ANALYSIS RESULTS

M.O.E. VERIFICATION STUDY

WATERLOO - SITE NO. 0084

PARAMETER	SP3-81			SP4-81		
	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982	Oct. 5, 1981	Feb. 2, 1982	June 7, 1982
pH	8.5	*	9.5	7.5	*	8.2
Conductivity (uS/cm)	1,550.	*	530.	960.	*	200.
Hardness as $CaCO_3$	391.	*	163.	475.	*	71.
Calcium as Ca	106.	*	32.	166.	*	28.
Magnesium as Mg	31.	*	20.	15.	*	0.2
Sodium as Na	31.	*	39.	3.3	*	5.0
Potassium as K	2.4	*	3.4	6.3	*	1.2
Alkalinity as $CaCO_3$	58.	*	41.	535.	*	69.
Sulphate as SO_4	330.	*	116.	3.	*	2.
Chloride as Cl	111.	*	71.	30.	*	15.
Iron as Fe	0.04	*	<0.01	0.03	*	0.08
COD	<25.	*	<25.	<25.	*	<25.
Phenols** (ug/L)	5.	*	1/2.	43.	*	3.

* Frozen

Note: 1) All results are expressed in mg/L except pH or as specified.
2) Magnesium is a calculated result.
3) Samples were filtered prior to analysis.
4) Analyses conducted by Conestoga-Rovers & Associates Limited.
5) **Indicates analyses conducted by Beak Analytical Services

Fe (total) at 0.02 to 22 mg/L, and COD at <25 to 130 mg/L. Phenols are found in low to moderately high concentrations of <1 to 15 ug/L. OW8-81 contains the highest level of contamination with chloride at 705 mg/L, alkalinity at 2,850 mg/L, COD at 631 mg/L, and phenols at 127 ug/L. These values are comparable to the lower range for typical leachates. Also the charge balance for OW8-81 was off by 49%, indicating that there are other chemicals in the sample that were not tested for.

Surface water chemistry indicates limited contamination of the pond (SP3-81) and the leachate spring (SP4-81), and unnoticeable contamination of Laurel Creek, upstream (SP1-81) and downstream (SP2-81).

5.5 LEACHATE PRODUCTION AND LOADING

The total area for the refuse deposit outlined on Map 3.1, is approximately 11,700 m^2. This does not include the section of Laurel Creek or the roadways that intersect the deposit. The mean annual precipitation for the City of Waterloo is 86.4 cm. The amount of infiltration is estimated to be less than 15% of the total

precipitation (based on soil conditions and drainage characteristics). Using a conservative estimate of 13.0 cm of infiltration, the leachate production is calculated to be approximately 4,200 L/day. The movement of leachate will be horizontal migration through the waste and underlying granular beds discharging to Laurel Creek. Using the average hydraulic conductivity of 7×10^{-4} cm/sec. calculated from the recovery tests of OW3-81, the rate of migration is calculated as

$$V = \frac{Ki}{S_y}$$

where i = 0.015 is the average horizontal gradient

S_y = 0.35 assumed specific yield

gradient for OW3-81. The average linear groundwater velocity (V) is approximately 1 meter/year.

Three chemical parameters (Cl, Fe and phenols) were used to estimate the loading of leachate on the site. Using the concentrations from the June 1982 samples, loading is calculated to be 1.0 kg/day for Cl, 0.012 kg/day for Fe (total) and 9×10^{-5} kg/day for phenols.

5.6 COMBUSTIBLE GAS MONITORING

Fourteen gas probes have been installed at the site. Eight of these probes (GMP1-81 to 6-81, 11-81, 12-81) are nested with observation wells within the refuse deposit. The remaining gas probes are located outside the refuse deposit to monitor for possible methane gas migration.

Table 5.3 presents the results of the combustible gas monitoring. The first sampling period on October 5, 1981 showed no combustible gas at any of the probes. The readings taken on November 8, 1981 indicate combustible gas at some of the gas probes. Probes containing methane show that elevated concentrations are generally present from November 1981 to February 1982, with concentrations decreasing by June 1982. GMP4-81 is an exception showing a considerable variation in results with a maximum of 37% in June 1982.

Gas probe GMP8-81 is located in refuse, but combustible gas was not detected. The refuse observed at this location was predominately construction material (bricks, tarpaper, glass), which are relatively inert. The remaining four probes (GMP9-81, GMP10-81, GMP13-81 and GMP14-81) were positioned to check lateral migration of combustible

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TABLE 5.3

COMBUSTIBLE GAS LEVELS

MONITORING DATES
(% Volume Methane)

Monitor	Oct. 5 1981	Nov. 7 1981	Dec. 8 1981	Jan. 8 1982	Feb. 2 1982	Mar. 4 1982	Apr. 8 1982	May 7 1982	June 7 1982
GMP1-81	0	15	15	7	17	11	8	1	7
GMP2-81	0	22	19	11	12	10	22	14	10
GMP3-81	0	22	25	16	15	10	8	11	14
GMP4-81	0	*	7	6	17	21	0	27	37
GMP5-81	0	33	28	14	22	14	0	0	3
GMP6-81	0	14	9	10	8	10	9	1	3
GMP7-81	0	0	4	9	<4	8	0	0	2
GMP8-81	0	0	0	0	0	0	*	0	0
GMP9-81	0	0	0	0	-	-	0	0	0
GMP10-81	0	0	0	-	-	-	*	-	-
GMP11-81	0	25	13	50	45	46	*	32*	0
GMP12-81	0	*	0	0	0	9	*	*	1
GMP13-81	0	0	0	-	-	-	-	0	0
GMP14-81	0	4	3	0	0	0	*	0	-
Valve Box	-	-	5	-	-	-	5	0	4
GMPA-81	*	*	*	*	*	*	*	-	-
GMPB-81	*	*	*	*	*	*	*	-	-

* Water in Probe

gas from the refuse deposits. GMP14-81 was the only probe to detect gas, but this was only twice and below the lower explosion limit.

Gas monitoring probes (GMPA-81, GMPB-81) were installed by the City of Waterloo, behind the houses on Dale Crescent as shown on Map 5.1. These probes filled with water soon after installation and have been inoperative ever since.

The water valve box at the entrance to the sewage treatment plant was monitored three times and contained a maximum of 5% combustible gas.

5.7 COMBUSTIBLE GAS GENERATION

For the purposes of determining the quality of combustible landfill gas being generated at the Waterloo Site, it is necessary to utilize literature values for gas production and then amend these values for the type of waste encountered at the site. An average gas production value of 0.015 kg/m^3 of wet refuse per year was utilized. The combustible gas portion of the landfill gas was assumed to comprise approximately 50% of the total landfill gas.

At Site No. 0084 using a refuse density of 590 kg/m^3 the volume of refuse was calculated to be 16,000 m^3 of which it is estimated that 15% to 25% of this refuse is putrescible. Using the above parameters, it is calculated that the annual volume of methane generated will range from 11,000 to 18,300 cubic meters per year.

5.8 SUMMARY

The site covers a relative large areal extent. The boundaries and general thickness of waste have been delineated, and the following conclusions can be made regarding the environmental impact of the site.

1) The area of refuse disposal extends for approximately 11,700 m^2 with the thickness of refuse ranging from 1 to 2 meters.

2) The type of waste is generally domestic with minor quantities of construction materials. The age of the waste varies from 18 years beside Parkview Cemetery to about 30 years beside the Waterloo Sewage Treatment Plant. In the unsaturated zone, putrescible refuse was not common and probably has decomposed. The refuse in the phreatic zone was

observed to be well preserved, especially the wood and paper products.

3) The leachate has relatively low concentrations for most chemical parameters compared to typical landfill leachate. The exception was OW8-81 which showed relatively high concentrations for most parameters including phenols. It should be noted that OW8-81 is included in the more recent refuse (8 years).

4) Groundwater flow hydraulics indicate a variable horizontal gradient to Laurel Creek depending on the topography and soil/refuse conditions. Hydraulic conductivities through the refuse and underlying sand and gravel beds are relatively high which would result in an effective hydraulic connection with Laurel Creek.

5) As a result of 4), leachate migration and discharge to Laurel Creek will occur, however the attenuation of most of the aqueous species, and the dilution properties of the creek are high as observed by the low concentrations in Laurel Creek.

6) There appears to be no significant existing or potential hazards from leachate generation and

migration as there are no water supply wells on or near the site. The only potential hazard could be the migration of phenols from the area of OW8-81 to Laurel Creek. The total quantity of flow is low and therefore, the creek should be able to assimilate this loading.

7) Combustible gas has been observed to be in moderately high concentrations at some locations of the site, however the rate of production is expected to be in relatively low volumes due to the small proportion of putrescible materials.

8) Lateral migration of combustible gas is not expected to be significant through the fine-grained soils.

9) The buildings currently located around the site are located a sufficient distance from the refuse that there appears to be no existing or potential hazards from landfill gas generation and migration.

10) No leachate springs were observed at the landfilling area near the sewage treatment plant. This could be attributed to the good soil cover (1 meter). Only one leachate spring was observed

near the Parkview Cemetery (SP4-81) and that flows for only a few meters before it is recharged back into the groundwater system approximately 100 meters from Laurel Creek.

11) There is no existing or potential hazard of leachate discharge to surface water courses however, some discharge to the creek is noted.

12) The site is presently comprised of inactive parklands, highway right-of-ways, part of a cemetery and an inactive section of the Waterloo Sewage Treatment Plant. Control of the site development within the foreseeable future would entail prevention of combustible gas migration into structures and/or services and the prevention of water supply wells in the upper section of the overburden.

5.9 RESULTS OF SITE INVESTIGATIONS, PHASE II - PART I

The Site Investigations for Site 0084 were limited to the area between University Avenue and the Sewage Treatment Plant. The investigation consisted of seven auger holes to a maximum depth of 1.53 meters. Only one auger hole encountered refuse.

Combustible gas was not detected in any of the auger holes, or in the houses monitored to the west of the site. Combustible gas was detected at 17.5% in the water valve box on the site. Water samples were collected from Laurel Creek, the tributary to Laurel Creek and the pond at the Sewage Treatment Plant. The chemical parameters were chloride at 60 mg/L, total iron at 1.5 mg/L, alkalinity at 154 mg/L and conductivity at 400 uS/cm for Laurel Creek; chloride at 210 mg/L, iron at <.2 mg/L, alkalinity at 376 mg/L and conductivity at 850 uS/cm for the tributary; and chloride at 300 mg/L, total iron at 0.7 mg/L, alkalinity at 205 mg/L and conductivity at 1650 uS/cm for the pond. Appendix D presents the Phase II - Part I report for Site 0084.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 VERIFICATION SITES

The following major conclusions and recommendations are formulated from the detailed Site Verification Investigation:

A) Site No. 0044 - Thorold

1) It is concluded that significant quantities of landfill gas are being generated at Site 0044. This gas presents a potential hazard to nearby buildings.
2) It is concluded from the work conducted as an extension of the Phase II - Part I study on the remainder of the filled in portion of the canal that there is significant potential for quantities of landfill gas to be generated and to cause a potential hazard to nearby buildings. It should be noted that this work was not part of the Verification Study, Phase II - Part II.
3) It is concluded that leachate generation and migration is not a significant hazard at this site and requires no further investigation.
4) It is recommended that a comprehensive landfill gas investigation program be undertaken along the complete length of the filled in portion of the old

Welland Canal. Emphasis should be placed on the areas of waste disposal and near buildings on or adjacent to these waste disposal areas.

B) Site No. 0062 - Grimsby

1) It is concluded that from the background information available, and the field investigations, no waste appears to have been deposited at this site.
2) It is recommended that no further investigations at this site are required.

C) Site No. 0084 - Waterloo

1) It is concluded that no significant existing or potential hazard with respect to landfill gas exists at this site.
2) It is concluded that there is no significant existing or potential hazard with respect to leachate generation and migration.
3) It is recommended that development control be exercised at this site to prevent any encroachment of buildings and/or services to the landfill areas without proper consideration for the presence of landfill gas.
4) It is recommended that no further site investigations are required at this location.

6.2 PHASE II - PART I ASSESSMENT

This section of the report provides general conclusions and recommendations which reflect on the recommended method of conducting site investigations to accurately determine if a hazard to the public health or safety exists at a particular location. It must be recognized that these conclusions and recommendations are general in nature and each site must be evaluated on its own merits.

1) It is concluded that the information derived from the Phase I and the Phase II - Part I studies, with respect to background information on the site provides a reasonable history of the site. The Phase II - Part II background review presents a more comprehensive review of the site with more particular information being gained on the areal extent of refuse disposal.

2) It is concluded that the field monitoring information obtained from the Phase II - Part I study, while being valuable, does not provide comprehensive monitoring data and cannot be solely used to judge if a hazard exists at a particular site.

3) It is concluded that it is necessary to properly instrument a site for landfill gas monitoring and to monitor with time to adequately address the hazards associated with respect to landfill gas.

4) In general, it can be stated that leachate loading from the sites investigated in the West Central Region under Phase II - Part I, has reached or past its maximum and is subsiding. Therefore, it is recommended any emphasis of future site investigation be placed more on landfill gas rather than groundwater and surface water contamination. If it is suspected that hazardous waste has been placed at the site, a comprehensive evaluation with respect to gas and leachate generation and migration would be required.

5) It is concluded that only sites which have an identifiable potential hazard from leachate generation and migration be further investigated using a more comprehensive program. In general, it can be stated that unless a water supply is being impacted, and/or significant discharge to a surface water course could be anticipated, no further detailed investigations are required.

6) It is recommended that in all sites where putrescible waste has been identified and a potential hazard could exist, a detailed landfill gas investigation program be undertaken. This investigation would include the installation of gas probes within the refuse itself and adjacent to nearby foundations. These gas probes should be monitored regularly by a qualified person and evaluated after sufficient data has been obtained to ascertain if a hazard exists.

7) It is recommended that if a site is suspected of having a disposed waste, however not verified by previous site inspections and a potential hazard could exist, a testhole or borehole be located in the suspected area to verify the situation. If putrescible material is not encountered at the site it is recommended that further investigations be discontinued. If putrescible material is encountered, it is recommended that a landfill gas investigation program be undertaken.

6.3 SITES REQUIRING FURTHER INVESTIGATION

From the Phase II - Part II Verification Study, it is concluded that to properly monitor for landfill gas it is necessary to install the monitors at the optimum location and depth and to monitor with time.

In the Phase II - Part I study, the recommendations for further monitoring for landfill gas were in general with respect to monitoring within the buildings themselves. However, the results of this study indicate that a more comprehensive monitoring should be undertaken at the waste disposal sites where putrescible material was identified. This monitoring should be within the waste disposal area itself and adjacent to the external foundations of the buildings. The data obtained from this method of monitoring would indicate if a potential hazard exists and whether further monitoring and/or remedial work is required. This recommendation applies to the following sites within the West Central Region: 8001, 8002, 8028, 0032, 0037, 0050, 0053, 0055, 0075, 0090, 0094, and E1. With the exception of Site 0090, all of the above sites recommended for monitoring were as recommended for some form of monitoring under Phase II - Part I. Site 0090 has identified waste products buried in the area near

a housing development and therefore it is recommended that a landfill gas study should be conducted at this site as well to ascertain if, in fact, a hazard does exist.

It is concluded that at a number of sites in the West Central Region the waste quantity and character were not adequately defined in the Phase II - Part I Study to assess if a hazard exists. Therefore, it is recommended that a field investigation program consisting of excavation using a backhoe or drill rig in the suspected waste area be undertaken to ascertain the waste type (if any) and quantity. If waste is encountered, which has a proportion of putrescible material, it is further recommended that a landfill gas investigation program be adopted. This recommendation applies to the following sites in the West Central Region: No. 0028, 0041, 0063, 0064, 0093, 0099, 8084A, 8084B and 0100.

Sites No. 0042 and 0043 were also recommended for further investigation under Phase II - Part I. However, these sites have since been investigated in detail by the City of Thorold. It is not known by the consultant if more comprehensive investigations of other sites within the West Central Region have been undertaken to date. If further

investigations of the sites have been undertaken, it is recommended that the program and results be reviewed by a qualified person as to the comprehensiveness of the study.

All of Which is Respectfully Submitted,

CONESTOGA-ROVERS & ASSOCIATES LIMITED

Anthony J. Crutcher, P. Eng.

William S. Clarke, M.Sc.

CONESTOGA-ROVERS & ASSOCIATES LIMITED

APPENDIX A

TERMS OF REFERENCE

May 22, 1981.

Conestoga Rovers
651 Colby Drive
WATERLOO, Ontario
N2v 1B4

Dear Sirs:

RE: VERIFICATION STUDIES:
SITE IDENTIFICATION PROGRAM

In accordance with the following requirements and attachments;

- List of Sites
- Terms of Reference
- Information for Consultants

a proposal is solicited to carry out and report on a selected list of old waste disposal sites previously identified during the inventory phase of the Site Investigation Study and Preliminary Field Studies.

Separate prices must be given for each site.

Background data is available for review for each site at regional offices (Toronto, Stoney Creek, London, Kingston) as well as the Waste Management Branch at 135 St. Clair Avenue West, Toronto. If this data is considered insufficient to prepare a comprehensive proposal, the consultants should visit the sites to obtain any necessary additional information.

This study is not to verify the results of the previous consultants' work during the preliminary field studies.

.../2

The purpose is to assess the methodology used during this study, (see attached Terms of Reference for Preliminary Field Studies), and to determine its effectiveness in uncovering potential problems.

The final summary report by the consultant will include a rationale for decision making processes in evaluating the need to study other sites documented in the "Inventory Study, 1980".

Further information may be obtained by contacting the Ministry Regional Office;

Southwestern Region
London Regional Office
985 Adelaide Street South
London, Ontario N6E 1V3

Mr. J. Bray

Sites: # 5027, 5060, 2063

or the Waste Management Branch office at 135 St. Clair Avenue West, Toronto (M. Wood, J. Petoia, L. Ficzere: 965-9670).

Yours very truly,

C. J. Macfarlane
Director
Waste Management Branch

Attachments

March 11, 1981

TERMS OF REFERENCE FOR:

VERIFICATION STUDY

For Waste Site Identification Study, Phase II, Part I

PREAMBLE

In 1979, the Ministry of the Environment, carried out Phase I of a study to inventory waste disposal sites which were in operation prior to 1971

Phase II of the study consists of two parts:

Part I

Preliminary field study of selected sites was carried out to determine potential environmental hazards to public health and safety of the site.

Part II

Will involve more detailed investigation of some of those sites where a potential problem was identified in Part I as well as some sites where no significant impacts were detected.

...../2

This verification study is intended to provide an evaluation of the validity of methodology used in the preliminary field studies.

The sites selected for this verification process will provide a wide variety of soil types, volumes of waste, age of waste, moisture regimes, etc. Analysis of results will be used to determine if any additional sites should be investigated based on analyses of conditions including proximity of development.

TERMS OF REFERENCE

VERIFICATION STUDY

The contractor shall:

1) Investigate each site in sufficient detail, using indicated parameters to determine whether a hazard exists to public health, public safety or the environment.
2) Determine the physical limits of the waste disposal site.
3) Determine the physical characteristics of the soil on the site, and also if the cover material is imported; determine the physical characteristics of the cover material.
4) Determine the hydrologic characteristics of the site.
5) Determine the hydrogeologic characteristics of the site.

...../3

6) Determine the general composition of the waste deposited in the site.

7) Determine the existing quantities by volume of the waste deposited in the site.

8) Estimate the quantity of leachate that will be produced in the future by the waste deposited in the site.

9) Estimate the quantity of gas (CH_4) that will be produced in the future by the waste deposited in the site.

10) Determine the chemical characteristics of the leachate.

11) Determine the "plume" of leachate migration.

12) Determine the "plume" of gas (CH_4) migration.

13) Design a monitoring system to sample, for a 12 month period at suitable intervals to be recommended by the consultant.

The contractor shall propose a list of any other parameters he intends to investigate on each site. The list will take into consideration the information collected on waste characteristics on the site. Additional in-depth interviews with appropriate people will improve level of confidence in type, age and quantities of waste.

14) Design a monitoring system to sample for a twelve month period at suitable intervals to be recommended by consultant, all water wells within 100 meters of the landfilling site and test for same as in point 13.

Note: Where sufficient data on background levels are not available, additional tests will be done to enable

.../4

comparisons between up and down stream samples.

15) Design a monitoring system to test each site and each building on, or immediately adjacent, for the presence of combustible gas (methane). The tests shall be carried out for a period of twelve months at monthly intervals. Test wells shall be constructed into the wastes on the site. Buildings should be tested in their basements. Quantities of gas (CH_4) that may enter into a basement should also be estimated.

16) Inspect the general condition of the final cover. Check that it is not eroded and confirm its depth.

17) Inspect the general area in and around the site to ascertain if there is any leachate spring.

18) Inspect the general area in and around the site to ascertain if there is any vegetation that has been affected by leachate or gas migration.

19) Where lot and concession numbers are not available, U.T.M. co-ordinates will be provided by the contractor.

20) The report should address, in particular, the results of this study compared to the results obtained during the "Preliminary Field Investigations" and provide a full evaluation of the methodologies. Recommendations should include a rationale for determining what additional sites may be considered candidates for further field testing.

.../5

GENERAL

The contractor shall collect a two (2) litre sample of water and forward it to a laboratory for analysis. (MOE laboratory facilities will not be provided for the contractor).

The occupants of homes using the water for supply shall be asked to describe any taste or odour problems. The local MOH should be contacted to determine if any unusual health problems exist in the community.

If hazard exists or is imminent, the contractor shall notify the Ministry of the Environment immediately on confirmation of test results.

The contractor shall identify abatement measures to remove any hazard identified in the field investigation and comment upon results of detailed investigation as compared to those from preliminary study.

Project Management

The study will be managed by a joint Steering Committee made up of representatives of MOE Waste Management Branch and the region where the work will be carried out. The consultant will carry out the study under the direction of the joint Steering Committee.

.../6

Consultant Proposals

Proposals are invited from consultants or teams of consultants capable of undertaking the study, analyses and report preparation. The consultant or team of consultants should have expertise in the areas of:

- Solid waste management practices,
- Surface and groundwater hydrology.

Consultant Proposal Contents

The proposal should include the consultant's interpretation of the requirements of the study, together with description of the approach planned to facilitate carrying out the terms of reference, together with a schedule of tasks and milestones including the timè required to complete the study.

In addition, the consultant should also provide:

1. A list of key personnel who will be assigned to the project with identification of the areas for which each will be responsible. A resume for each person should be included.
2. A description of team structures and accountabilities,
3. A detailed cost estimate which includes man power costs by individual or level and the per diem rate.
4. A very brief review of any recent assignments on similar projects.

...../7

Time and Cost Estimates

Consultants are to provide cost estimates to the joint Steering Committee for each individual site that will be investigated in the project. A work program detailing the time each site is investigated should be presented. The consultant will immediately notify the regional representative of any changes to the work schedule.

Meetings and Proposals

Monthly progress reports will be provided by the consultants to the joint Steering Committee and meetings will be held at least once per month or as specifically requested.

Six copies of the draft final report shall be provided to the joint Steering Committee, and after authorization of the draft, twenty copies of the final report will be required. The final report will be in a format to be determined by the joint Steering Committee.

The final report must be concise and well presented. The final report will be completed at the earliest possible date and in no case later than Aug. 31, 1982.

The Evaluation of Proposals

Each proposal will be evaluated by the members of the joint Steering Commitee based on:

...../8

1. The consultant's understanding of the Terms of Reference and the scope of the project;
2. The approach suggested to fulfill the Terms of Reference;
3. The experience, expertise and organization of the consultant or team of consultants assembled;
4. Cost and timing.

Applicants may be required to attend an interview conducted by members of the joint Steering Committee. A consultant or team of consultants will be selected to carry out the study consequent to the interviews.

The joint Steering Committee reserves the right to reject any or all proposals.

April 9, 1981

INFORMATION FOR CONSULTANTS

1. The consultant will submit a detailed work schedule showing staff, resources and time allocations to all phases of the study.

2. The consultant will submit a list of individuals with their qualifications who will be working on the project.

3. The consultant will submit an itemized breakdown of the price showing cost for each site, estimated living expenses, phone calls, etc. and any other associated study costs.

4. The work will be completed and a written report submitted, in 20 copies, to the Ministry by Aug. 31, 1982.

5. Progress meetings will be held as specified.

6. Progress payments will be paid monthly after presentation of invoices supported by receipts or other documents to establish that the invoice is for amounts reasonably incurred or earned in connection with the study.

7. The consultant will be responsible for obtaining, at his own expense, all things necessary that are required to perform the study including any laboratory facilities.

8. The consultant will provide a contingency allowance which will not be used throughout the study without the written permission of the M.O.E.

9. All salaries and expenses related to personnel assigned to the project will be subject to M.O.E. approval as being reasonable. Amounts equivalent to the A.P.E.O. schedule of salaries and fees dated August, 1980, or amendments thereto, with any necessary changes to reflect rates of remuneration for different jobs, will be accepted as reasonable.

10. In the event work falls behind the schedule, the M.O.E. may cancel further work by the consultant without prejudice to any other rights and remedies available to the M.O.E.

11. The M.O.E. may cancel the contract at any time and its only obligation will be to pay the consultant for all work done to the date of cancellation and for any future expenses which the consultant remains legally obliged to pay in connection with the study and for which the consultant is not otherwise reimbursed.

12. The Minister of the Environment is the agent of Her Majesty for all purposes of the contract. Nothing contained in or omitted from the contract shall restrict any of the rights or power of Her Majesty or the Minister.

13. Without the written approval of the M.O.E. in advance, the M.O.E. shall not be liable to pay more than the price bid for the study.

14. The M.O.E. shall have the right to inspect or audit any records of the consultant or anyone working directly or indirectly for the consultant for the purposes of the study to determine that any amount for which the M.O.E. is involved is reasonable in amount and has been properly incurred for the purposes of the study.

15. All data, information and industrial property such as patents, trade marks, industrial design and copyright acquired or developed through the study become the exclusive property of the M.O.E. and will not be divulged to other parties without written consent of the M.O.E.

16. Personnel will not be assigned to the study without written approval from the M.O.E.

17. The successful applicant will act as an independent consultant and not as a servant or agent of the M.O.E.

18. The Director of the Waste Management Branch of the Ministry of the Environment or a person designated by him in writing may act for the M.O.E. in connection with the contract.

19. M.O.E. means Her Majesty the Queen in the Right of Ontario as represented by the Minister of the Environment.

20. The consultant will report the information obtained and findings on each site on forms I and II provided by the M.O.E. The forms will be submitted as required to the regional representative and the head office. Instructions for completing forms will be provided.

21. Site information (original data sheets) can be reviewed at M.O.E. regional offices and the Waste Management Branch, 135 St. Clair Avenue West, Toronto.

22. M.O.E. regional representatives are available for site visits at the request of the consultant.

23. Proposals in 10 copies will be required no later than June 26, 1982.
to the Ministry of the Environment, Waste Management Branch, 2nd Floor, 135 St. Clair Avenue West, Toronto, M4V 1P5.

APPENDIX B

SITE NO. 0044 - THOROLD

CONESTOGA-ROVERS & ASSOCIATES LIMITED

TABLE B-1 WATER WELL LOGS

CONESTOGA-ROVERS & ASSOCIATES LIMITED

WATER WELL NO.: 1

OWNER: K. Sherry

M.O.E. WELL NO.: 66-1629

DATE: May, 1949

FROM	TO (Feet)	DESCRIPTION
0	9	Clay
9	30	Limestone

Water Found	- 28 Feet	Elev. of Water Found	- 565 Feet
Static Level	- 8 Feet	Elev. of Static Level	- 585 Feet
Pumping Level	- 12 Feet		
Test Pumping Rate	- 25 GPM		
Test Time	- 2/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 6.25 Gpm/Ft	Ground Elevation	- 593 Feet

WATER WELL NO.: 2

OWNER: Thorold Conc. Block

M.O.E. WELL NO.: 66-1628

DATE: July, 1950

FROM	TO (Feet)	DESCRIPTION
0	10	Clay
10	48	Blue Clay
48	50	Stones
50	52	Limestone

Water Found	- 52 Feet	Elev. of Water Found	- 528 Feet
Static Level	- 10 Feet	Elev. of Static Level	- 570 Feet
Pumping Level	- 23 Feet		
Test Pumping Rate	- 15 GPM		
Test Time	- 2/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 1.15 Gpm/Ft	Ground Elevation	- 580 Feet

WATER WELL NO.: 3

OWNER: K. Sherry

M.O.E. WELL NO.: 66-1630

DATE: May, 1949

FROM	TO (Feet)	DESCRIPTION
0	19	Clay
10	28	Blue Clay
28	29	Stones
29	30	Limestone

Water Found	- 29 Feet	Elev. of Water Found	- 564 Feet
Static Level	- 10 Feet	Elev. of Static Level	- 583 Feet
Pumping Level	- 15 Feet		
Test Pumping Rate	- 25 GPM		
Test Time	- 1/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 1.50 Gpm/Ft	Ground Elevation	- 593 Feet

WATER WELL NO.: 2

OWNER: C.A. Kelsey

M.O.E. WELL NO.: 66-1632

DATE: July, 1953

FROM	TO (Feet)	DESCRIPTION
0	6	Clay
6	28	Blue Clay
28	36	Limestone

Water Found	- 36 Feet	Elev. of Water Found	- 559 Feet
Static Level	- 12 Feet	Elev. of Static Level	- 583 Feet
Pumping Level	- 30 Feet		
Test Pumping Rate	- 4 GPM		
Test Time	- 2/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.22 Gpm/Ft	Ground Elevation	- 595 Feet

WATER WELL NO.: 5

OWNER: British Am. Oil Co.

M.O.E. WELL NO.: 38-1727

DATE: July, 1955

FROM	TO (Feet)	DESCRIPTION
0	17	Clay
17	22	Brown Clay
22	26	Limestone

Water Found	- 25 Feet	Elev. of Water Found	- 568 Feet
Static Level	- 13 Feet	Elev. of Static Level	- 580 Feet
Pumping Level	- 20 Feet		
Test Pumping Rate	- 3 GPM		
Test Time	- 2/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.43 Gpm/Ft	Ground Elevation	- 593 Feet

WATER WELL NO.: 6

OWNER: E.A. Jesck

M.O.E. WELL NO.: 66-1645

DATE: May, 1960

FROM	TO (Feet)	DESCRIPTION
0	25	Blue Clay
25	28	Clay Stones
28	36	Limestone

Water Found	- 30 Feet	Elev. of Water Found	- 564 Feet
Static Level	- 16 Feet	Elev. of Static Level	- 578 Feet
Pumping Level	- 30 Feet		
Test Pumping Rate	- 10 GPM		
Test Time	- 2/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.71 Gpm/Ft	Ground Elevation	- 594 Feet

WATER WELL NO.: 7

OWNER: R. Sutton

M.O.E. WELL NO.: 66-1643

DATE: August, 1949

FROM	TO (Feet)	DESCRIPTION
0	12	Clay
12	23	Blue Clay
23	25	Medium Sand
25	28	Limestone

Water Found	- 27 Feet	Elev. of Water Found	- 566 Feet
Static Level	- 8 Feet	Elev. of Static Level	- 585 Feet
Pumping Level	- 15 Feet		
Test Pumping Rate	- 15 GPM		
Test Time	- 1/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 2.14 Gpm/Ft	Ground Elevation	- 593 Feet

WATER WELL NO.: 8

OWNER: E Knight

M.O.E. WELL NO.: 38-794

DATE: February, 1953

FROM	TO (Feet)	DESCRIPTION
0	22	Blue Clay
22	38	Limestone

Water Found	- 36 Feet	Elev. of Water Found	- 523 Feet
Static Level	- 10 Feet	Elev. of Static Level	- 549 Feet
Pumping Level	- 10 Feet		
Test Pumping Rate	- 10 GPM		
Test Time	- 2/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- Gpm/Ft	Ground Elevation	- 559 Feet

WATER WELL NO.: 9

OWNER: G. Hartley

M.O.E. WELL NO.: 66-1639

DATE: September, 1949

FROM	TO (Feet)	DESCRIPTION
0	20	Clay
20	35	Blue Clay
35	42	Limestone

Water Found	- 40 Feet	Elev. of Water Found	- 542 Feet
Static Level	- 10 Feet	Elev. of Static Level	- 572 Feet
Pumping Level	- 42 Feet		
Test Pumping Rate	- 10 GPM		
Test Time	- 1/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.31 Gpm/Ft	Ground Elevation	- 582 Feet

WATER WELL NO.:

OWNER:

M.O.E. WELL NO.:

DATE:

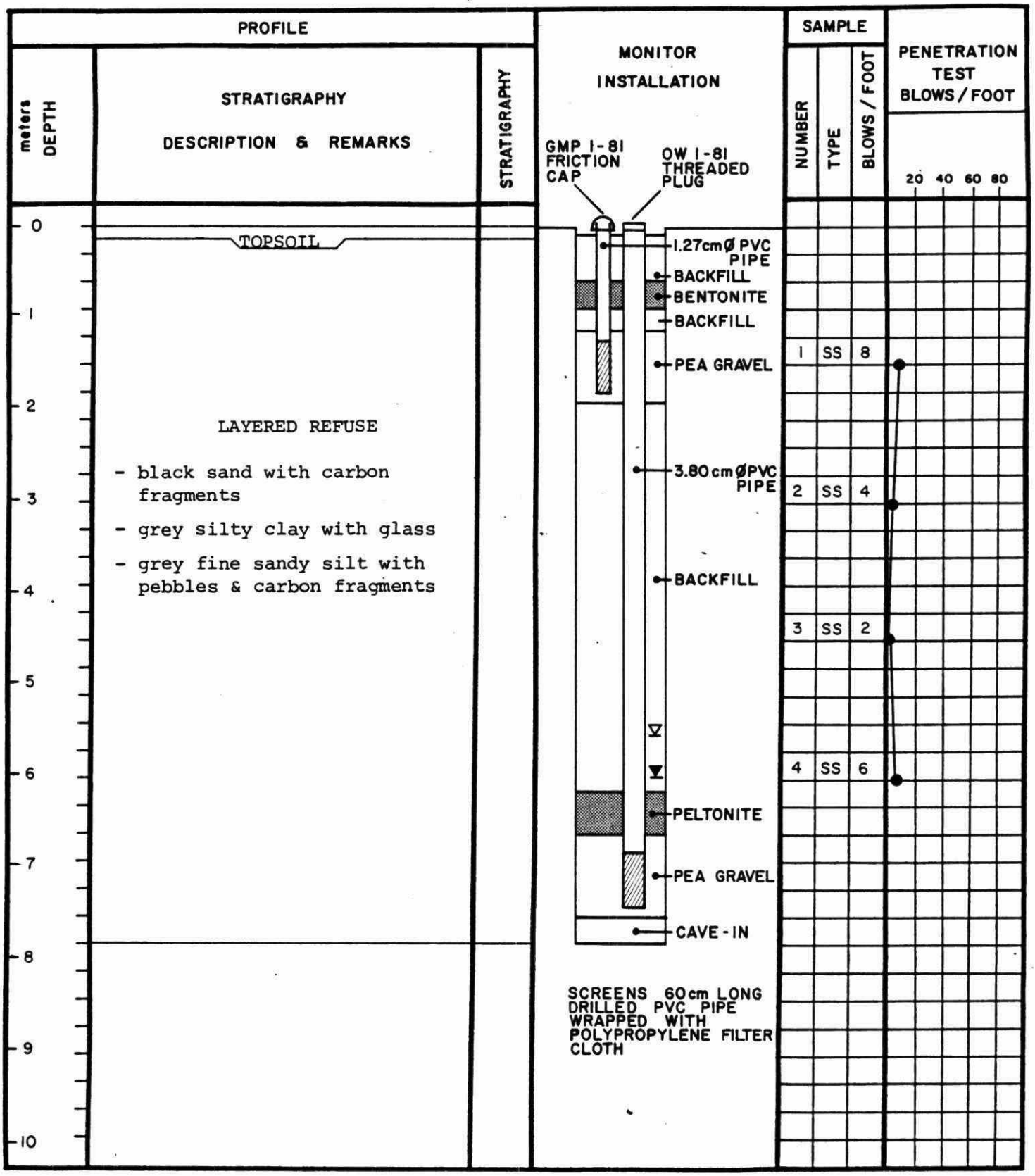
FROM	TO (Feet)	DESCRIPTION

Water Found	- Feet	Elev. of Water Found	- Feet
Static Level	- Feet	Elev. of Static Level	- Feet
Pumping Level	- Feet		
Test Pumping Rate	- GPM		
Test Time	- Hr/Min	Water Quality	- Fresh
Specific Capacity	- Gpm/Ft	Ground Elevation	- Feet

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0044 - Thorold

HOLE Nº: OW1-81
DATE COMPLETED: September 2, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 176.49 m
TOP OF PIPE ELEVATION: 176.470 m



WATER TABLE ▼
STATIC LEVEL ▽ SEPT. 15, 1981

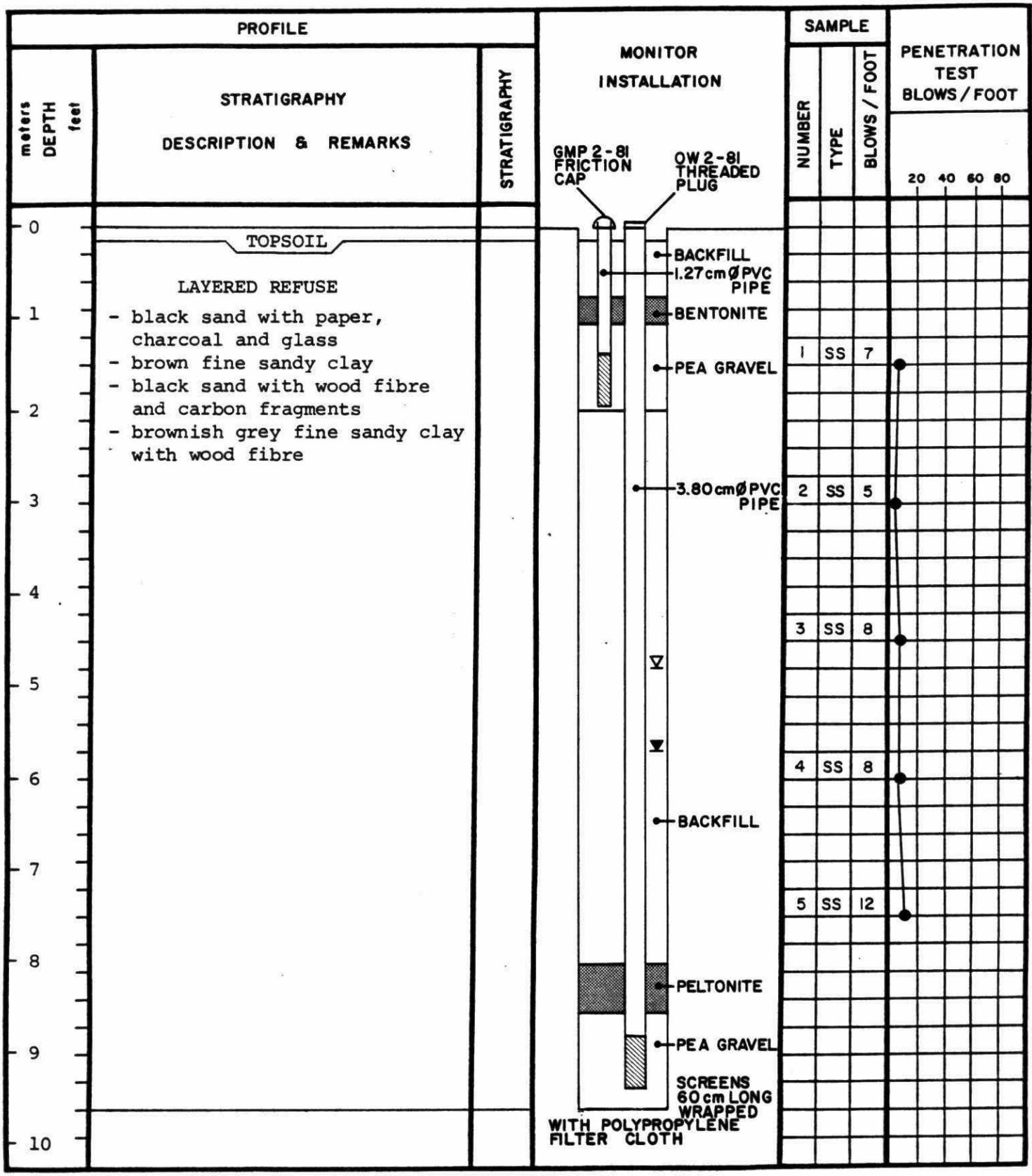
CRA

CONESTOGA-ROVERS & ASSOCIATES

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0044 - Thorold

HOLE Nº: OW2-81
DATE COMPLETED: September 2, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 173.33 m
TOP OF PIPE ELEVATION: 173.321 m



WATER TABLE ▼
STATIC LEVEL ▽ SEPT. 15, 1981

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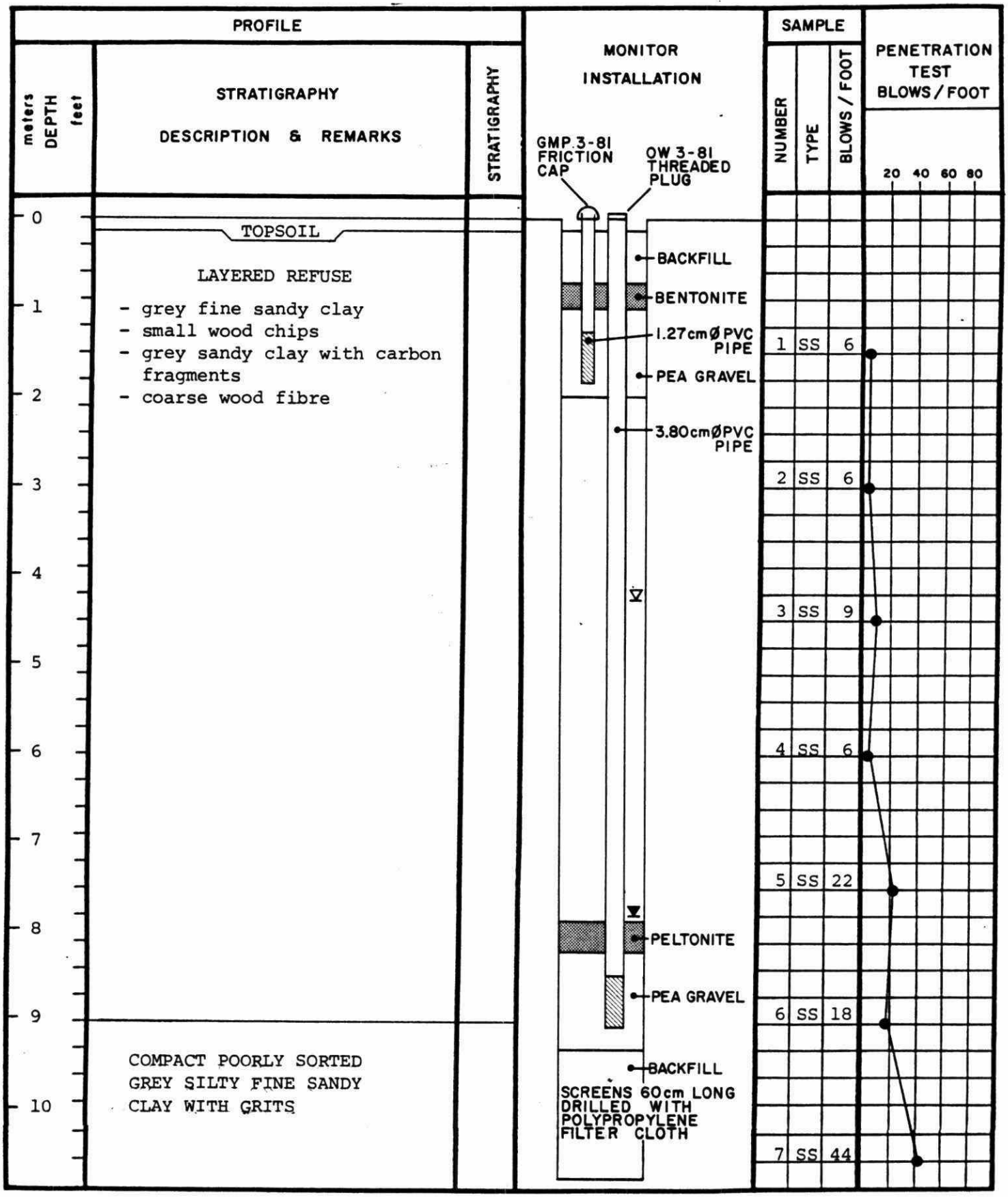
STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0044 - Thorold

HOLE Nº: OW3-81
DATE COMPLETED: September 2, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 172.04 m
TOP OF PIPE ELEVATION: 172.038 m



WATER TABLE ▼
STATIC LEVEL ▽ SEPT. 15, 1981

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STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0044 - Thorold

HOLE Nº: OW4-81
DATE COMPLETED: September 3, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 176.10 m
TOP OF PIPE ELEVATION: 176.092 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 4-81 FRICTION CAP; OW 4 - 81 THREADED PLUG				
	LAYERED REFUSE - brown silty clay with charcoal fragments - grey fine sandy clay with glass and wood fibre - grey silty clay with wire and wood fibre - coarse wood fibre		1.27cm Ø PVC PIPE BACKFILL BENTONITE PEA GRAVEL	1	SS	18	
1							
2				2	SS	6	
3							
4			3.80cm Ø PVC PIPE	3	SS	7	
5			BACKFILL				
6			▽	4	SS	11	
7			PELTONITE				
8			PEA GRAVEL	5	SS	8	
9			SCREENS 60cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER				

WATER TABLE ▼
STATIC LEVEL ▽ SEPT. 15, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0044 - Thorold

HOLE Nº: GMP5-81
DATE COMPLETED: September 3, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 175.30 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 5-81 FRICTION CAP				
1	REFUSE - plastic bags, metal scraps, paper & wood fiber in a black sandy matrix		1.27cm Ø PVC PIPE BACKFILL PELTONITE				
2			PEA GRAVEL				
3			SCREEN 60cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				
4							

WATER TABLE ▼
STATIC LEVEL ▽

CRA

JONES LOG

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0044 - Thorold

HOLE Nº: GMP6-81
DATE COMPLETED: September 3, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 174.65 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0			GMP 6-81 FRICTION CAP				
	TOPSOIL						
	REFUSE - wood fibre in balck sandy matrix		1.27cmØ PVC PIPE				
1			BACKFILL				
	REFUSE - plastic fragments & wood fibre in brown sandy clay matrix		PELTONITE				
2			PEA GRAVEL				
3			SCREEN 60cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0044 - Thorold

HOLE Nº: GMP7-81
DATE COMPLETED: September 3, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 172.62 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 7-81 FRICTION CAP				
1	BROWN SILTY FINE SAND CLAY FILL		1.27cm Ø PVC PIPE; BACKFILL; PELTONITE	1	AS		
2	REFUSE - paper, wood fibre, plastics, wire & cloth in black sandy matrix		PEA GRAVEL				
3			SCREEN 60cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0044 - Thorold

HOLE Nº: GMP8-81
DATE COMPLETED: September 3, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 171.95 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0			GMP 8-81 FRICTION CAP				
	TOPSOIL		1.27cm Ø PVC PIPE				
	GREY PEBBLY SANDY FILL		BACKFILL	1	AS		
1							
	REFUSE - metal scraps & wire in brown silty clay matrix		PELTONITE				
2			PEA GRAVEL				
3			SCREEN 60cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽

CRA

TABLE B-3 BOREHOLE LOGS FROM PORTABLE AUGER

BH9-81

DEPTH		DESCRIPTION
From	To (meters)	
0	1.5	Light brown silty clay

Comments

GMP9-81 installed 1.4 meters blow ground surface.

BH10-81

DEPTH		DESCRIPTION
From	To (meters)	
0	1.4	Grey silty clay fill with pieces of concrete, asphalt and gravel

Comments

GMP10-81 installed 1.2 meters below ground surface.

BH11-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Topsoil
0.1	1.5	Brown silty clay

Comments

GMP11-81 installed 1.4 meters below ground surface.

BH12-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Topsoil
0.1	1.5	Brown silty clay

Comments

GMP12-81 installed 1.2 meters below ground surface.

CONESTOGA-ROVERS & ASSOCIATES LIMITED

BH13-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Topsoil
0.1	1.5	Brown silty clay

Comments

GMP13-81 installed 1.4 meters below ground surface.

BH14-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Topsoil
0.1	1.0	Red silty medium sand
1.0	1.4	Black sandy fill (possibly refuse)

Comments

GMP14-81 installed 1.4 meters below ground surface.

BH15-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Topsoil
0.1	1.5	Grey clayey silt

Comments

GMP15-81 installed 1.5 meters below ground surface.

BH16-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Gravel
0.1	1.5	Grey silty clay fill with gravel

Comments

GMP16-81 installed 1.4 meters below ground surface.

BH17-81

DEPTH		DESCRIPTION
From	To (meters)	
0	1.5	Grey silty clay

Comments

GMP17-81 installed 1.5 meters below ground surface.

BH18-81

DEPTH		DESCRIPTION
From	To (meters)	
0	1.5	Reddish brown silty clay

Comments

GMP18-81 installed 1.4 meters below ground surface.

BH19-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Topsoil
0.1	1.5	Brown silty clay fill with gravel

Comments

GMP19-81 installed 1.5 meters below ground surface.

BH20-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Topsoil
0.1	0.3	Brown silty clay fill with gravel
0.3	1.5	Black sandy fill (possibly refuse)

Comments

GMP20-81 installed 1.5 meters below ground surface.

ONESTOGA ROVERS & ASSOCIATES LIMITED

BH21-81

DEPTH		DESCRIPTION
From	To (meters)	
0	1.1	Brown silty sand fill

Comments

GMP21-81 installed 1.1 meters below ground surface.

BH22-81

DEPTH		DESCRIPTION
From	To (meters)	
0	1.5	Red silty sand fill

Comments

GMP22-81 installed 1.4 meters below ground surface.

BH23-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Topsoil
0.1	1.5	Grey silty clay

Comments

GMP23-81 installed 1.5 meters below ground surface.

BH24-81

DEPTH		DESCRIPTION
From	To (meters)	
0	0.1	Course gravel
0.1	0.3	Black sandy fill (possibly refuse)
0.3	1.5	Brown silty clay with gravel

Comments

GMP24-81 installed 1.5 meters below ground surface.

BH25-81

DEPTH		DESCRIPTION
From	To (meters)	
0	1.2	Brown silty sand fill

Comments

GMP25-81 installed 1.2 meters below ground surface.

TABLE B-4

PHASE I - PART I STUDY REPORT

FOR SITE NO. 0042, 0043 and 0044

PREPARED BY:

GARTNER LEE ASSOCIATES LIMITED

NOVEMBER, 1980

CONESTOGA-ROVERS & ASSOCIATES LIMITED

SITE 0044

BATTLE OF BEAVERDAM PARK
BETWEEN SULLIVAN AVENUE & LYNDON STREET,
THOROLD

CONCLUSIONS AND RECOMMENDATIONS

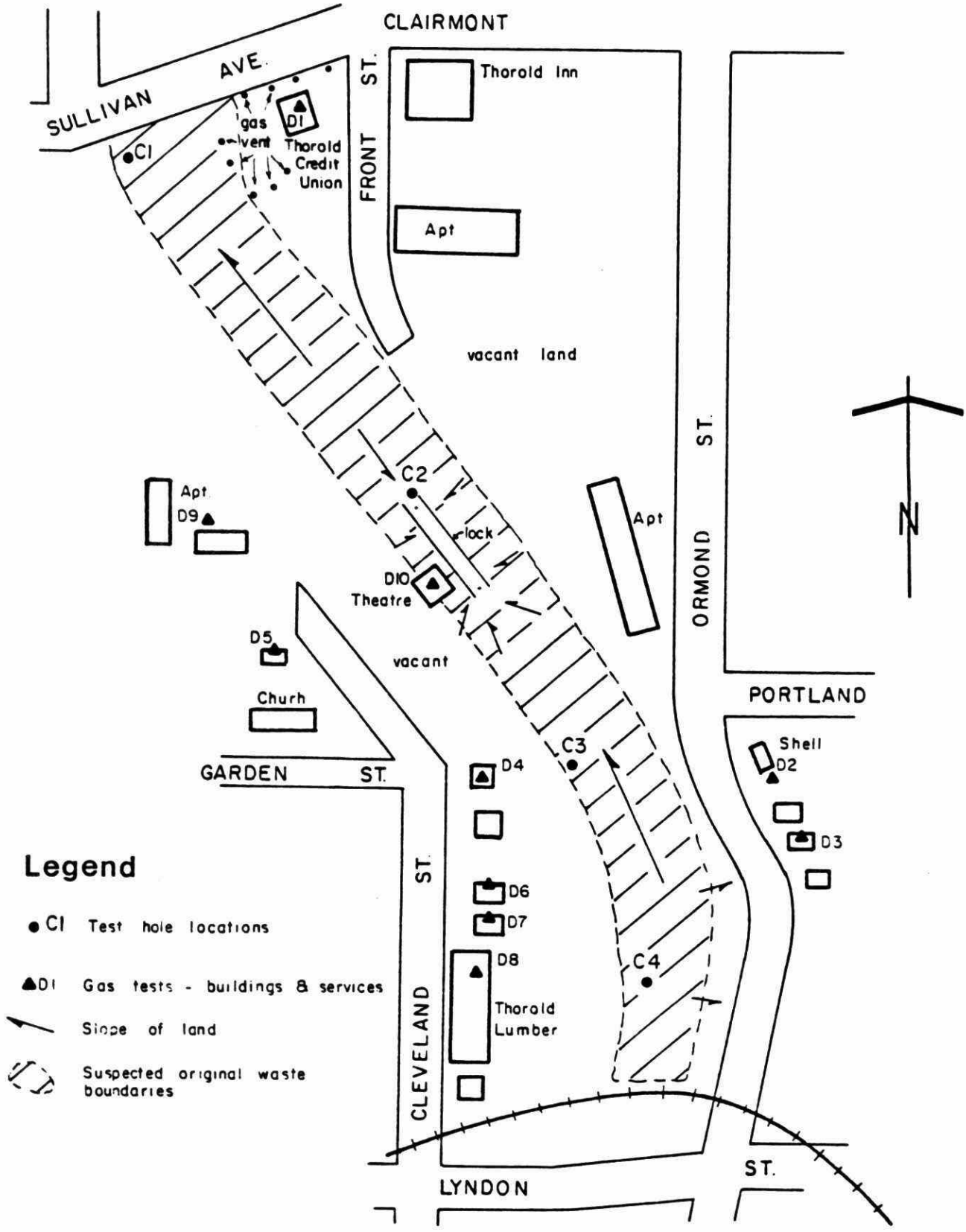
Our test holes intersected mainly earth fill, although locally fragments of brick and glass, charcoal and plastic were mixed with the earth. The abandoned Welland Canal channel has been entirely filled and thus there may be domestic refuse at depth, below the penetration of the test holes.

Methane gas problems were reported during the construction of the Thorold Community Credit Union. As a result gas vents were installed around the building. We had a reading of 2% combustible gas from one of the vents. No gas was detected anywhere else on the site or in adjacent buildings. Leachate is not a problem at this site.

In view of the apparent potential of methane gas migration, we recommend that detailed subsurface investigations be initiated at all adjacent structures and the buildings be monitored for gas at 2 week intervals over the winter. The need for a properly engineered and constructed gas venting system should be based on these future study findings.

CONESTOGA-ROVERS & ASSOCIATES LIMITED

SITE 0044



SCALE 1:2400

Ministry of the Environment
Ontario

(To be completed in duplicate, 1 copy to MOE Regional office, 1 copy to MOE Head office)

FORM I
(Site Identification Stud

SITE INSPECTION

MOE REGION WEST CENTRAL DATE September 24, 1980 SITE IDENTIFICATION CODE 0044

SITE BATTLE OF BEAVERDAM PARK BETWEEN SULLIVAN AVENUE & LYNDON STREET, THOROLD
(Lot, concession #, or UTM coordinates, name, address)

ON-SITE TESTS

I Leachate

A. WATER BODIES WITHIN 100 METRES NONE

Parameter	Results									
	1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

B. WELLS WITHIN 100 METRES NONE

Parameter	Results									
	1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

Any significant odour problems Yes ____ No ____ Comments NO WATER BODIES OR WELLS WITHIN 100 m

LAB TESTS (2 LITRE SAMPLES)

Required, Yes ____ No X If Yes, complete Form II, Lab Analysis. If No, go to Part II, Gas.

II Gas

C. ON-SITE

Test Holes	Results	Test Holes	Results
#1	0%	#6	
#2	0%	#7	
#3	0%	#8	
#4	0%	#9	
#5		#10	

D. BUILDINGS

Name/Address	Results	Name/Address	Results
1. THOROLD COMM. CREDIT UNION	0%	6. 8 CLEVELAND ST.	0%
2. 54 ORMOND (SHELL)	0%	7. 10 CLEVELAND ST.	0%
3. 62 ORMOND	0%	8. 20 CLEVELAND ST (THOROLD LUMBER	0%
4. 2 CLEVELAND ST.	0%	9. 59A & B CLEVELAND ST.	0%
5. 3 CLEVELAND ST.	0%	10. THEATRE	

III General Comments (vegetation, leachate springs, depth, etc.) REFUSE WAS PLACED IN AN ABANDONED WELLAND CANAL CHANNEL. AREA IS NOW A PARK - GRASSED WITH TREES. NO SIGN OF LEACHATE. GAS WAS NOT DETECTED IN THE TEST HOLES OR SEWER MANHOLES. THERE WERE ALLEGED GAS PROBLEMS WITH THE CREDIT UNION BUILDING DURING CONSTRUCTION AND THUS GAS VENTS WERE INSTALLED. A CONCENTRATION OF 2% GAS WAS DETECTED IN ONE OF THE VENTS. A GAS MONITORING PROGRAM INCLUDING ADJACENT BUILDINGS AND SOIL MONITORS SHOULD BE INITIATED TO IDENTIFY ANY POTENTIAL PROBLEMS.

(Detail all test point locations in a sketch on reverse side)

Form completed by: D E Jagger

MOE 1640A/80

AUGER HOLE LOGS
SITE 0044

C1

0 - 0.13 m	Topsoil
0.13 - 0.76 m	Medium to dark brown slightly clayey silt with odd pebbles, moist.
0.76 - 0.92 m	Brown clayey silt mixed with charcoal, plastic - moist
0.92 - 1.68 m	Grey clayey silt fill - moist
1.68 m	No further penetration, stone. 0% Gas

C2

0 - 0.61 m	Medium to dark brown slightly clayey silt - odd stones, moist
0.61 - 1.68 m	Grey clayey silt mixed with odd fragments of brick, wetter than plastic limit. 0% Gas

C3

0 - 0.79 m	Brown clayey silt - DTPL
0.79 m	No further penetration, stone. 0% Gas

C4

0 - 1.53 m	Brown clayey silt fill, DTPL becoming WTPL at 1.53 m
1.53 m	No further penetration, stone. 0% Gas

SITE 0042

CANADIAN VAPOTRED, THOROLD

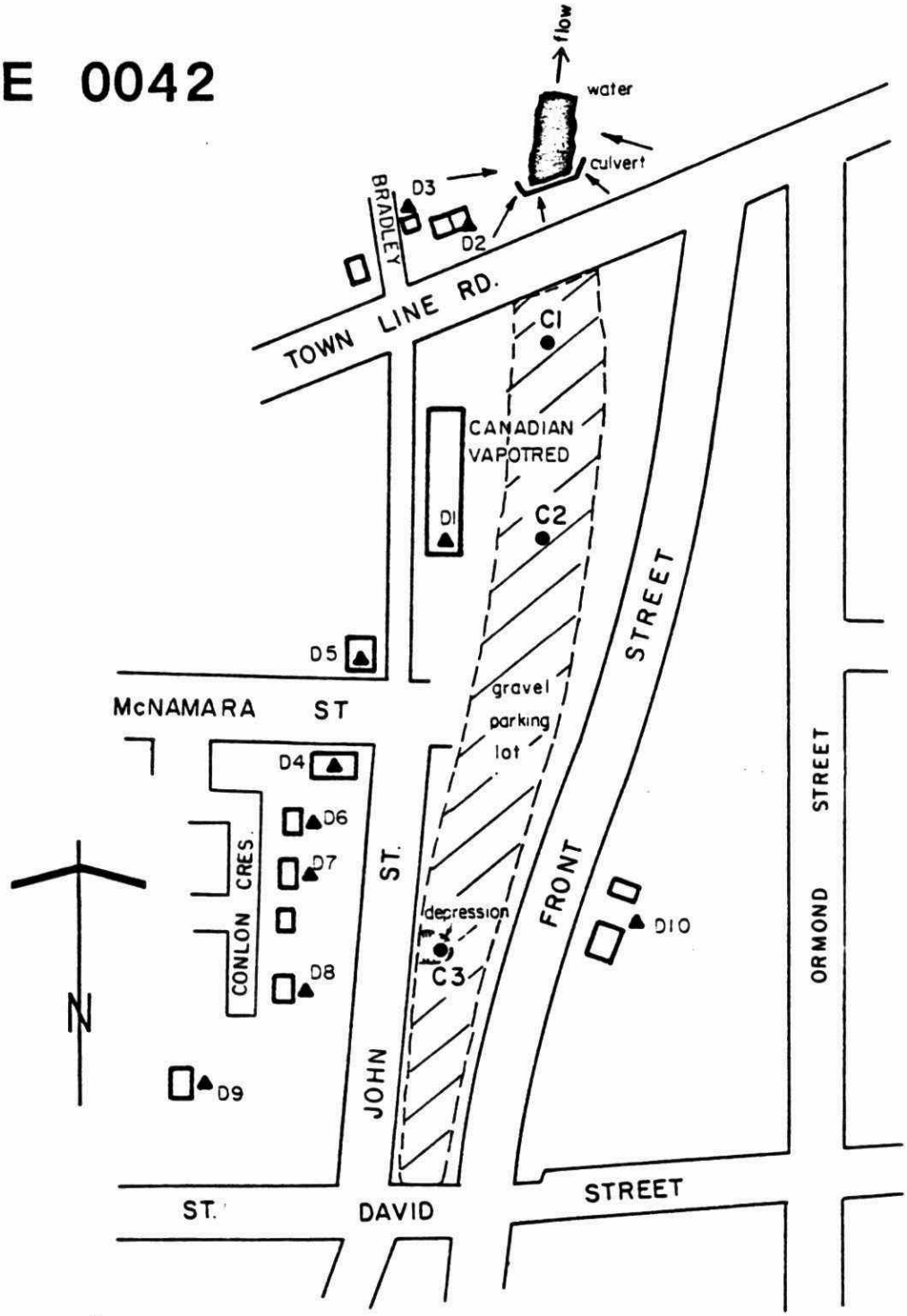
CONCLUSIONS AND RECOMMENDATIONS

This site forms part of an abandoned Welland Canal system. According to City records, the former channel was filled with domestic refuse probably mixed with earth/construction material. Due to the bouldery and stony nature of the cover material, our testholes did not penetrate to the garbage, although fragments of glass, brick and cinder were observed in the surficial cover. No gas was detected in the testholes or the adjacent buildings. However, it is reported by others that combustible gas was found in the soils around the Canadian Vapotred building during a soils investigation. Leachate does not appear to be a problem at this site.

We recommend that further gas monitoring be initiated to identify any potential problems, particularly with the existing Canadian Vapotred building. As well gas aspects should be reviewed for any new construction in the area.

CONESTOGA-ROVERS & ASSOCIATES LIMITED

SITE 0042



Legend

● C1 Test hole locations

▲ D1 Gas tests - buildings & services

Suspected original waste boundaries

SCALE 1:2400

Ministry of the Environment
Ontario

(To be completed in duplicate, 1 copy to MOE Regional office, 1 copy to MOE Head office)

FORM I
(Site Identification Stu

SITE INSPECTION

MOE REGION WEST CENTRAL DATE September 24, 1980 SITE IDENTIFICATION CODE 0042

SITE CANADIAN VAPOTRED - AREA BETWEEN ST. DAVID ST., JOHN ST., FRONT ST. & TOWNLINE ROAD, THOROLD
(Lot, concession #, or UTM coordinates, name, address)

ON-SITE TESTS

I Leachate

A. WATER BODIES WITHIN 100 METRES

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

B. WELLS WITHIN 100 METRES NONE

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

Any significant odour problems Yes X No Comments STORM SEWER WHICH IS LOCATED UNDER THE FILLS ACCORDING TO LOCAL INFORMATION DISCHARGES INTO AN OPEN CHANNEL NORTH OF THE SITE. NOT SAMPLED. GREEN IN COLOUR AND STRONG ODOUR. CULVERT ESTIMATED AT 15' WIDE, 8' HIGH AND FLOWING HALF FULL.

LAB TESTS (2 LITRE SAMPLES)

Required, Yes ___ No X If Yes, complete Form II, Lab Analysis. If No, go to Part II, Gas.

II Gas

C. ON-SITE

Test Holes	Results	Test Holes	Results
#1	0%	#6	
#2	0%	#7	
#3	0%	#8	
#4		#9	
#5		#10	

D. BUILDINGS

Name/Address	Results	Name/Address	Results
1. CANADIAN VAPOTRED	0%	6. 3 CONLON CRES.	0%
2. 22 TOWNLINE ROAD	0%	7. 5 CONLON CRES.	0%
3. 4 BRADLEY	0%	8. 9 CONLON CRES.	0%
4. 55 JOHN ST.	0%	9. 14 ST. DAVIDS	0%
5. 57 JOHN ST.	0%	10. 100, 110 FRONT ST. (VACANT)	0%

III General Comments (vegetation, leachate springs, depth, etc.) WASTES AND FILL WERE PLACED IN AN ABANDONED WELLAND CANAL CHANNEL; MAY BE UP TO 6 m DEEP. MOST OF THE AREA IS A PARKING LOT - CRUSHED STONE SURFACE - FOR TRANSPORTS. NORTHERN SECTION IS VACANT LAND COVERED WITH WEEDS. OUR INVESTIGATION DID NOT DETECT ANY GAS. HOWEVER PREVIOUS SOILS INVESTIGATION FOR THE EXPANSION OF THE CANADIAN VAPOTRED BUILDING FOUND GAS IN THE SOIL. WE SUGGEST FURTHER MONITORING, FOR BOTH EXISTING AND PROPOSED BUILDINGS.

(Detail all test point locations in a sketch on reverse side)

Form completed by: D. E. Sayers

MOE 1640A/80

AUGER HOLE LOGS
SITE 0042

C1

0 - 0.1 m	Topsoil
0.1 - 0.51 m	Brown clayey silt - DTPL
0.51 - 0.76 m	Brown gravelly sand with stones, moist
0.76 - 1.07 m	Grey silt fill - moist
1.07 m	No further penetration, stones, trace of gas

C2

0 -0.075 m	Topsoil
0.075-0.71 m	Brown crushed stone, silt and trace garbage
0.71 m	No further penetration, stones. No gas detected

C3

0 - 1.53 m	Dark brown clayey silt mixed with cinder, broken glass, drier than plastic limit becoming wetter than plastic limit with depth. 0% Gas

SITE 0043

AREA EAST OF TOW PATH STREET
BETWEEN ALBERT & SULLIVAN,
THOROLD

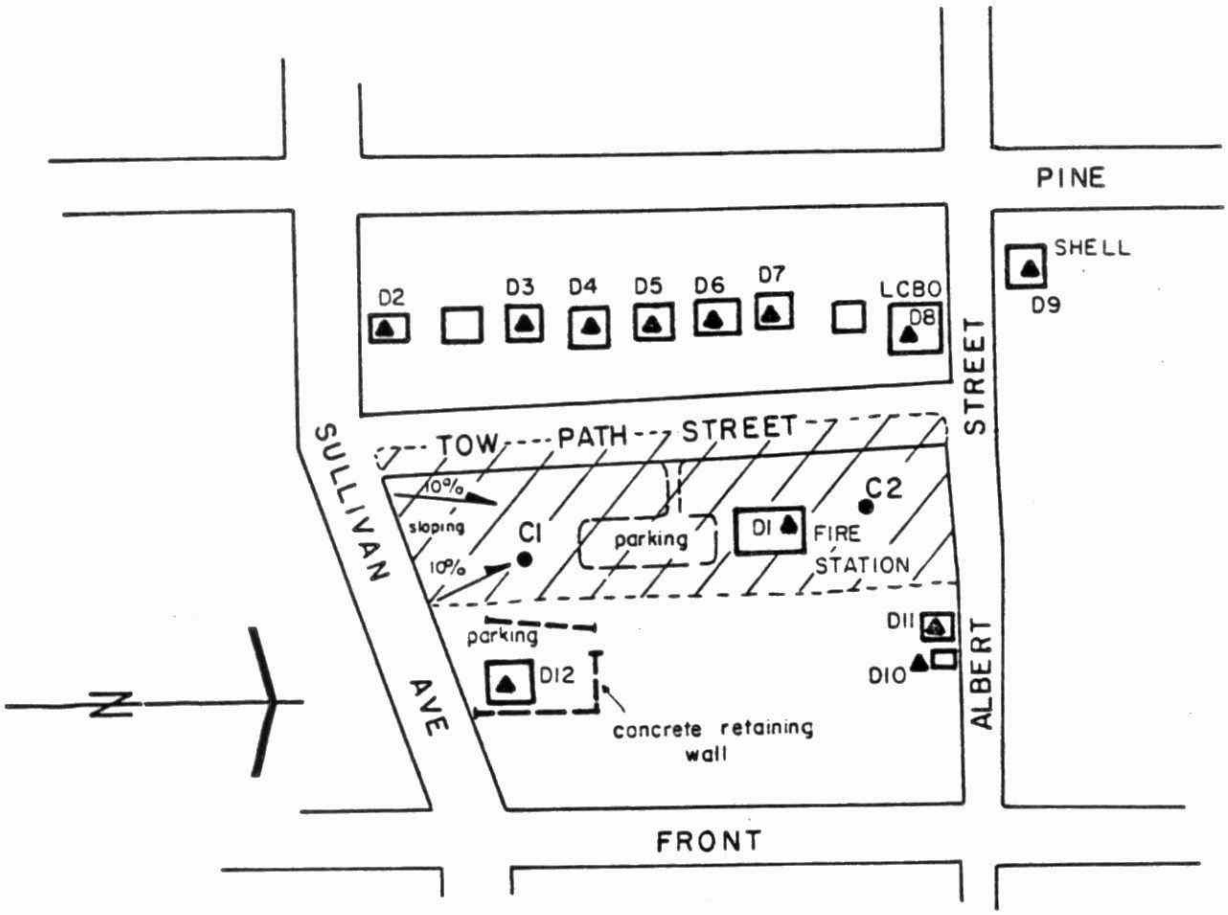
CONCLUSIONS AND RECOMMENDATIONS

The field investigation showed a surficial layer of earth fill mixed with fragments of glass, brick and cinder covering the area. Manual penetration was limited to 1 m due to the bouldery and stony nature of the fill. City records indicate that wastes were placed in this abandoned Welland Canal channel and may be in the order of 5 to 7 m deep. No combustible gas was detected in the test holes, buildings or services. Leachate does not appear to be a problem at this site.

We recommend, as a precautionary measure, that the Fire Hall, the structures along Tow Path Street and buildings number 9 and 138 Albert Street be monitored for combustible gas during the winter months, say from December 1 to April 30, every 2 weeks.

CONESTOGA-ROVERS & ASSOCIATES LIMITED

SITE 0043



Legend

● C1 Test hole locations

▲D1 Gas tests - buildings & services

Suspected original waste boundaries

SCALE 1:2400

Ministry of the Environment
Ontario

(To be completed in duplicate, 1 copy to MOE Regional office, 1 copy to MOE Head office)

FORM I
(Site Identification Stud

SITE INSPECTION

MOE REGION WEST CENTRAL DATE September 24, 1980 SITE IDENTIFICATION CODE 0043

SITE AREA EAST OF TOW PATH STREET BETWEEN ALBERT & SULLIVAN, THOROLD

(Lot, concession #, or UTM coordinates, name, address)

ON-SITE TESTS

I Leachate

A. WATER BODIES WITHIN 100 METRES NONE

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

B. WELLS WITHIN 100 METRES NONE

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

Any significant odour problems Yes ____ No X Comments NO WATER BODIES OR WELLS WITHIN 100 m OF THE SITE

LAB TESTS (2 LITRE SAMPLES)

Required, Yes ____ No X If Yes, complete Form II, Lab Analysis. If No, go to Part II, Gas.

II Gas

C. ON-SITE

Test Holes	Results	Test Holes	Results
#1	0%	#6	
#2	0%	#7	
#3		#8	
#4		#9	
#5		#10	

D. BUILDINGS

Name/Address	Results	Name/Address	Results
1. FIREHALL	0%	6. 17 TOW PATH	0%
2. 8 SULLIVAN AVE.	0%	7. 15 TOW PATH	0%
3. 29 TOW PATH ST.	0%	8. 15 ALBERT ST (LCBO)	0%
4. 25 TOW PATH ST.	0%	9. 18 ALBERT ST (SHELL STN)	0%
5. 21 TOW PATH ST.	0%	10. 9 ALBERT ST.	0%

III General Comments (vegetation, leachate springs, depth, etc.)

THOROLD FIRE DEPT. STATION LOCATED ON SITE. REMAINDER OF SITE IS GRASSED WITH ODD TREES. NO SIGN OF GAS OR LEACHATE. GARBAGE WAS NOT INTERSECTED ALTHOUGH SOME GLASS BRICK WERE MIXED WITH THE SURFACE FILLS. REFUSE AND FILLS ARE PROBABLY DEEP AS SITE CORRESPONDS TO AN ABANDONED WELLAND CANAL CHANNELSUGGEST FUTURE MONITORING OF THE FIRE STATION AND BUILDINGS ALONG TOW PATH STREET.

(Detail all test point locations in a sketch on reverse side)

Form completed by: D E Sayers

MOE 1640A/80

Ministry of the Environment
Ontario

(To be completed in duplicate, 1 copy to MOE Regional office, 1 copy to MOE Head office)

FORM I
(Site Identification Stu

SITE INSPECTION

MOE REGION _____ DATE _____ SITE IDENTIFICATION CODE 0043

SITE _____
(Lot, concession #, or UTM coordinates, name, address)

ON-SITE TESTS

I Leachate

A. WATER BODIES WITHIN 100 METRES

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

B. WELLS WITHIN 100 METRES

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

Any significant odour problems Yes____ No____ Comments _____

LAB TESTS (2 LITRE SAMPLES)

Required, Yes____ No____ If Yes, complete Form II, Lab Analysis. If No, go to Part II, Gas.

II Gas

C. ON-SITE

Test Holes	Results	Test Holes	Results
#1		#6	
#2		#7	
#3		#8	
#4		#9	
#5		#10	

D. BUILDINGS

Name/Address	Results
11. 13B ALBERT ST. (SEAWAY TAXI)	0%
12. 4 SULLIVAN AVE.	0%
13. STREET DRAINS & MANHOLES	0%

Name/Address	Results
6.	
7.	
8.	
9.	
10.	

III General Comments (vegetation, leachate springs, depth, etc.) _____

(Detail all test point locations in a sketch on reverse side)

MOE 18 ...80 [redacted] Form completed by [redacted]

AUGER HOLE LOGS
SITE 0043

C1

0	- 0.025 m	Topsoil
0.025	- 0.31 m	Dark brown clayey silt fill, DTPL
0.31	- 0.92 m	Dark brown clayey silt mixed with brick, stone, cinder and broken glass fill - moist
0.92 m		No further penetration, stone. No gas detected.

C2

0	- 0.075 m	Topsoil
0.075	- 0.31 m	Dark brown clayey silt fill - DTPL
0.31	- 0.76 m	Dark brown clayey silt mixed with brick, stone and broken glass
0.76 m		No further penetration, stone, No gas detected.

CONESTOGA-ROVERS & ASSOCIATES LIMITED

APPENDIX C

SITE NO. 0062 - GRIMSBY

TABLE C-1 WATER WELL LOGS

WATER WELL NO.: 1

OWNER: British Am. Oil Co.

M.O.E. WELL NO.: 38-1727

DATE: July, 1955

FROM	TO (Feet)	DESCRIPTION
0	15	Red Clay
15	60	Red Shale

Water Found	- 25 Feet	Elev. of Water Found	- 255 Feet
Static Level	- 10 Feet	Elev. of Static Level	- 270 Feet
Pumping Level	- 40 Feet		
Test Pumping Rate	- 5 GPM		
Test Time	- 00/3 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.13 Gpm/Ft	Ground Elevation	- 280 Feet

WATER WELL NO.: 2

OWNER: S. Jaross

M.O.E. WELL NO.: 38-1728

DATE: November, 1955

FROM	TO (Feet)	DESCRIPTION
0	55	Clay Gravel
55	57	Red Clay Gravel
57	69	Red Shale

Water Found	- 65 Feet	Elev. of Water Found	- 225 Feet
Static Level	- 32 Feet	Elev. of Static Level	- 258 Feet
Pumping Level	- 50 Feet		
Test Pumping Rate	- 1 GPM		
Test Time	- Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.06 Gpm/Ft	Ground Elevation	- 290 Feet

WATER WELL NO.: 3

OWNER: OWRC River Basin Br.

M.O.E. WELL NO.: 38-2039

DATE: August, 1970

FROM	TO (Feet)	DESCRIPTION
0	1	Black Topsoil
1	3	Brown Clay Stones
3	32	Grey Clay Stones
32	36	Red Clay Stones
36	124	Red Shale

Water Found	- Feet	Elev. of Water Found	- Feet
Static Level	- 15 Feet	Elev. of Static Level	- 235 Feet
Pumping Level	- 20 Feet		
Test Pumping Rate	- 2 GPM		
Test Time	-00/03 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.40 Gpm/Ft	Ground Elevation	- 250 Feet

WATER WELL NO.: 4

OWNER: H. Shultz

M.O.E. WELL NO.: 38-2559

DATE: September, 1976

FROM	TO (Feet)	DESCRIPTION
0	12	Packed Brown Clay
12	15	Hard Red Clay Gravel
15	50	Layered Red Shale

Water Found	- 15 Feet	Elev. of Water Found	- 259 Feet
Static Level	- 4 Feet	Elev. of Static Level	- 270 Feet
Pumping Level	- 45 Feet		
Test Pumping Rate	- 1 GPM		
Test Time	- 4/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- Gpm/Ft	Ground Elevation	- 274 Feet

WATER WELL NO.: 5

OWNER: E. Raab

M.O.E. WELL NO.: 38-2467

DATE: June, 1975

FROM	TO (Feet)	DESCRIPTION
0	4	Brown Clay Stones
4	23	Red Shales

Water Found	- 13 Feet	Elev. of Water Found	- 263 Feet
Static Level	- 2 Feet	Elev. of Static Level	- 274 Feet
Pumping Level	- 18 Feet		
Test Pumping Rate	- 10 GPM		
Test Time	- 1/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.63 Gpm/Ft	Ground Elevation	- 276 Feet

WATER WELL NO.: 6

OWNER: D. Williamson

M.O.E. WELL NO.: 38-1263

DATE: July, 1951

FROM	TO (Feet)	DESCRIPTION
0	20	Red Clay
20	52	Red Shale

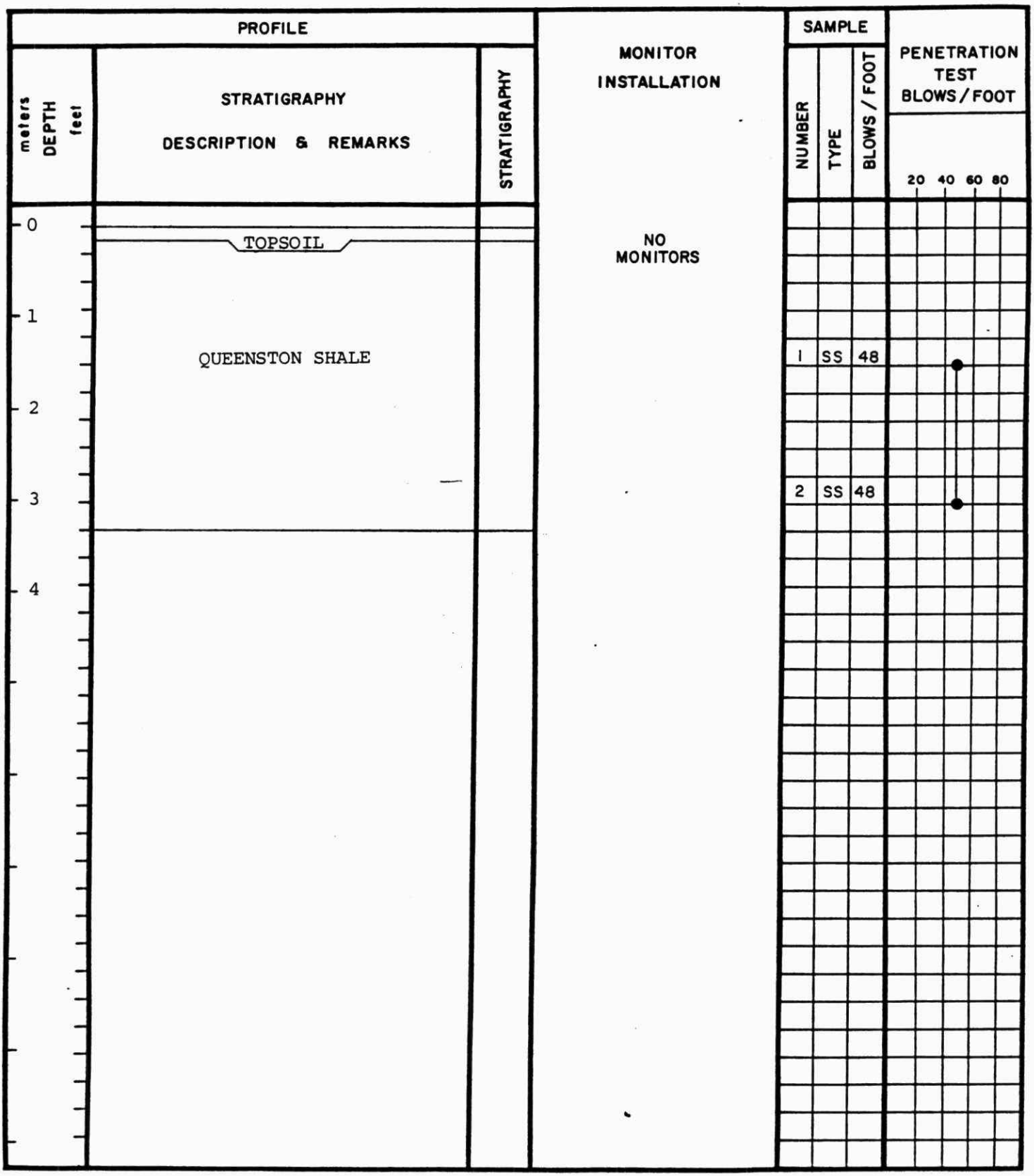
Water Found	- 45 Feet	Elev. of Water Found	- 235 Feet
Static Level	- 10 Feet	Elev. of Static Level	- 270 Feet
Pumping Level	- Feet		
Test Pumping Rate	- GPM		
Test Time	- Hr/Min	Water Quality	- Fresh
Specific Capacity	- Gpm/Ft	Ground Elevation	- 280 Feet

TABLE C-2 STRATIGRAPHIC AND INSTRUMENTATION LOGS

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0062 - Grimsby

HOLE Nº: BH1-81
DATE COMPLETED: September 2, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: ± 88.5 m
TOP OF PIPE ELEVATION:



WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0062 - Grimsby

HOLE Nº: BH2-81
DATE COMPLETED: September 2, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: ± 88.5 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		NO MONITORS				
1	QUEENSTON SHALE			1	SS	32	●
2							
3							

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0062 - Grimsby

HOLE Nº: BH3-81
DATE COMPLETED: September 2, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: ± 88.5
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		NO MONITORS				
1	QUEENSTON SHALE			1	SS	54	●
2							

WATER TABLE ▼
STATIC LEVEL ▽

CRA

TABLE C-3

PHASE II - PART I STUDY REPORT

FOR SITE NO. 0062

PREPARED BY:

GARTNER LEE ASSOCIATES LIMITED

NOVEMBER, 1980

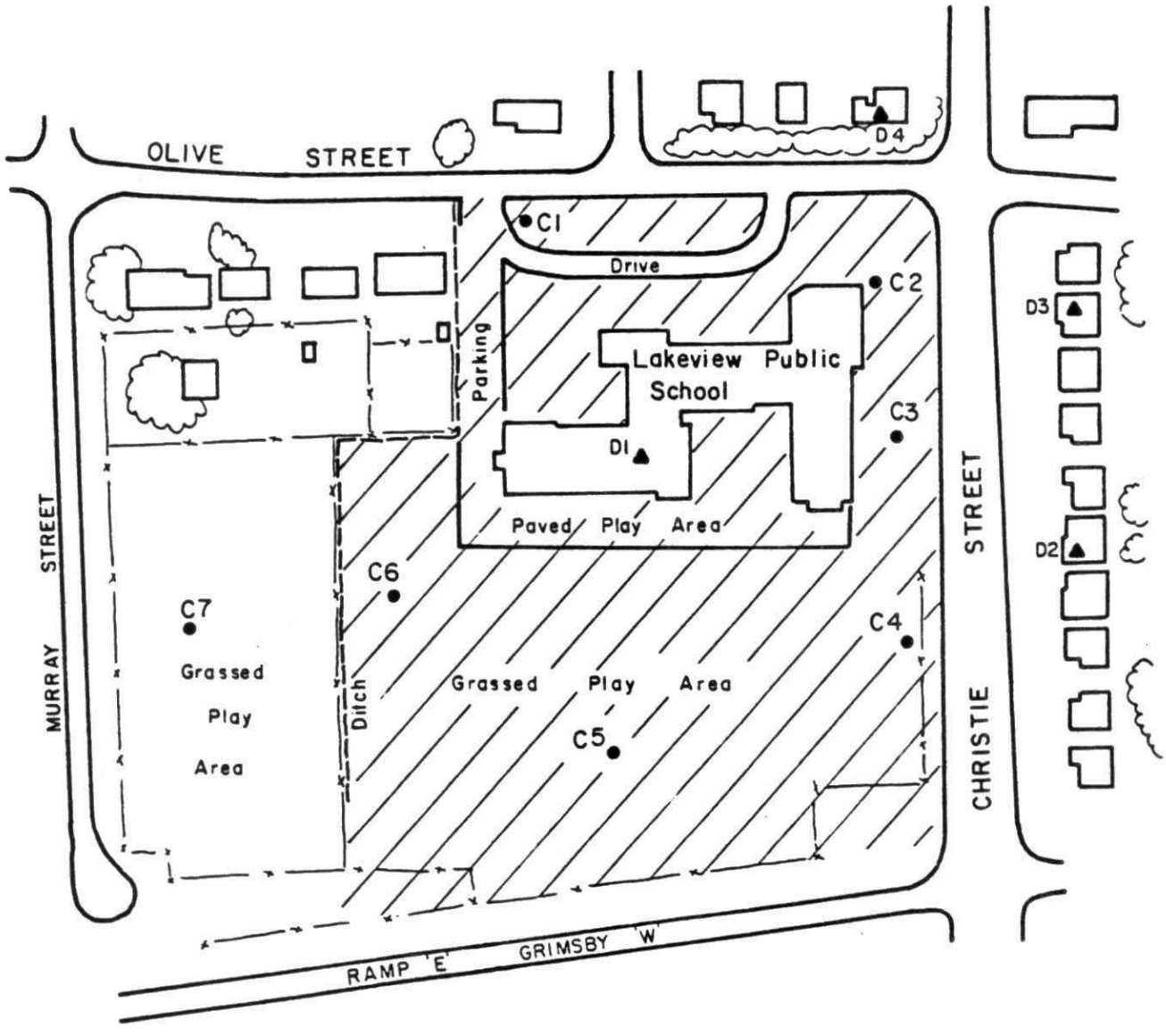
SITE 0062

CONCLUSIONS AND RECOMMENDATIONS

Our field investigation did not intersect any wastes at the locations checked and within the depths penetrated. However based on information supplied by both the M.O.E. and local residents, this area was apparently used for disposal, and it is alleged that there are cannery wastes in the site. No combustible gas was detected in the test holes, the school which is located on the site, and the buildings which were checked around the site. Leachate does not appear to be a problem.

As a precautionary measure, we recommend that the school building be monitored for combustible gas every two weeks from December 1 to April 30, 1981. These results should be reviewed and the need for additional work and/or monitoring based on the findings.

SITE 0062



Legend

- ● C1 Test hole locations
- ▲ D1 Gas tests- buildings & services
- Suspected original waste boundaries

SCALE 1:2,000

Ministry of the Environment
Ontario

(To be completed in duplicate, 1 copy to MOE Regional office, 1 copy to MOE Head office)

FORM I
(Site Identification Stud

SITE INSPECTION

MOE REGION WEST CENTRAL DATE October 3, 1980 SITE IDENTIFICATION CODE 0062

SITE LAKEVIEW PUBLIC SCHOOL - CHRISTIE AND OLIVE STREETS, GRIMSBY
(Lot, concession #, or UTM coordinates, name, address)

ON-SITE TESTS

I Leachate

A. WATER BODIES WITHIN 100 METRES

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

B. WELLS WITHIN 100 METRES

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

Any significant odour problems Yes ____ No X Comments NO WATER BODIES OR WELLS WITHIN 100 m

LAB TESTS (2 LITRE SAMPLES)

Required, Yes ____ No X If Yes, complete Form II, Lab Analysis. If No, go to Part II, Gas.

II Gas

C. ON-SITE

Test Holes	Results	Test Holes	Results
#1	0%	#6	0%
#2	0%	#7	0%
#3	0%	#8	
#4	0%	#9	
#5	0%	#10	

D. BUILDINGS

Name/Address	Results	Name/Address	Results
1. LAKEVIEW PUBLIC SHCOOL	0%	6.	
2. 388 CHRISTIE ST.	0%	7.	
3. 396 CHRISTIE ST.	0%	8.	
4. 92 OLIVE ST.	0%	9.	
5.		10.	

III General Comments (vegetation, leachate springs, depth, etc.) NO GARBAGE OR REFUSE WAS LOCATED ON THIS SITE. THE SITE IS NOW THE LAKEVIEW PUBLIC SCHOOL PROPERTY. EXCEPT FOR THE BUILDING PARKING AREAS, THE LANDS ARE GRASSED. NO APPARENT PROBLEMS; HOWEVER PRECAUTIONARY MONITORING OF THE SOIL FOR THE PRESENCE OF GAS IS SUGGESTED.

(Detail all test point locations in a sketch on reverse side)

Form completed by: D.E. Agnew

MOE 1640A/80

AUGER HOLE LOGS
SITE 0062

C1

0	- 0.05 m	Topsoil
0.05	- 0.64 m	Red brown silt - moist
0.64 m		NFP stone
		0% Gas.

C2

0	- 0.05 m	Topsoil
0.05	- 0.21 m	Crushed stone
0.21 m		No further progress - Asphalt
		0% Gas

C3

0	- 0.05 m	Topsoil
0.05	- 0.61 m	Red brown silt with stones, pebbles - moist
0.61	- 0.71 m	Dark brown clayey silt
0.71	- 1.22 m	Red brown lightly mottled clayey silt - fractured at plastic limit
		0% Gas

C4

0	- 0.21 m	Grey silt - moist
0.21	- 0.53 m	Mixed red brown and grey silt - moist
0.53	- 0.92 m	Red brown silt with shale fragments - moist
		0% Gas.

C5

0	- 0.025m	Topsoil
0.025	- 0.23 m	Grey brown silt - moist
0.23	- 0.46 m	Mottled clayey silt - moist
0.46	- 0.92 m	Red brown silt with shale fragments.
		0% Gas.

C6

0	- 0.23 m	Medium brown silt
0.23	- 0.61 m	Dark grey clayey silt - odd cinder - drier than plastic limit
0.61	- 0.76 m	Dark red brown clayey silt - drier than plastic limit
		0% Gas

C7

0	- 0.23 m	Brown silt with grits and pebbles - moist
0.23	- 0.46 m	Medium brown silt - moist
0.46	- 0.76 m	Dark red brown silt with shale fragments - moist. 0% Gas.

APPENDIX D

SITE NO. 0084 - WATERLOO

CONESTOGA-Rovers & Associates LIMITED

TABLE D-1 WATER WELL LOGS

©ONESTOGA-ROVERS & ASSOCIATES LIMITED

WATER WELL NO.: 1

OWNER: A. Acher

M.O.E. WELL NO.: 65-871

DATE: November, 1958

FROM	TO (Feet)	DESCRIPTION
0	1	Topsoil
1	26	Gravel
26	120	Clay Gravel
120	140	Yellow Clay Gravel
140	145	Clay Silt
145	170	Clay Gravel
170	188	Limestone

Water Found	- 180 Feet	Elev. of Water Found	- 906 Feet
Static Level	- 56 Feet	Elev. of Static Level	- 1029 Feet
Pumping Level	- 64 Feet		
Test Pumping Rate	- 12 GPM		
Test Time	-16/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 1.50 Gpm/Ft	Ground Elevation	- 1085 Feet

WATER WELL NO.: 2

OWNER: Waterloo PVC

M.O.E. WELL NO.: 65-3649

DATE: November, 1971

FROM	TO (Feet)	DESCRIPTION
1	6	Brown Topsoil
26	26	Brown Clay
54	54	Grey Clay
59	59	Grey Medium Sand
74	74	Grey Clay Sand
104	104	Grey Clay
107	107	Grey Fine Sand
121	121	Brown Gravel
125	125	Brown Limestone

Water Found	- 54 Feet	Elev. of Water Found	- Feet
Static Level	- Feet	Elev. of Static Level	- Feet
Pumping Level	- Feet		
Test Pumping Rate	- GPM		
Test Time	- Hr/Min	Water Quality	- Fresh
Specific Capacity	- Gpm/Ft	Ground Elevation	- 1075 Feet

WATER WELL NO.: 3

M.O.E. WELL NO.: 65-3347

OWNER: Corp. City of Waterloo

DATE: February, 1971

FROM	TO (Feet)	DESCRIPTION
0	1	Black Topsoil
1	36	Brown Gravel
36	75	Brown Medium Sand Clay
75	76	Grey Hardpan
76	78	Grey Gravel

Water Found	- 77 Feet	Elev. of Water Found	- 1023 Feet
Static Level	- 40 Feet	Elev. of Static Level	- 1060 Feet
Pumping Level	- 60 Feet		
Test Pumping Rate	- 10 GPM		
Test Time	-24/10 Hr/Min	Water Quality	- Fresh
Specific Capacity	- 0.50 Gpm/Ft	Ground Elevation	- 1100 Feet

WATER WELL NO.: 4

M.O.E. WELL NO.: 65-835

OWNER: C. Becthel

DATE: 11/79

FROM	TO (Feet)	DESCRIPTION
0	7	Black Topsoil
7	57	Clay
57	94	Sand
94	222	Hardpan
222	237	Limestone

Water Found	- 90 Feet	Elev. of Water Found	- 1010 Feet
Static Level	- 90 Feet	Elev. of Static Level	- 1010 Feet
Pumping Level	- Feet		
Test Pumping Rate	- GPM		
Test Time	-36/00 Hr/Min	Water Quality	- Fresh
Specific Capacity	- Gpm/Ft	Ground Elevation	- 1100 Feet

WATER WELL NO.: 5

OWNER: PUC

M.O.E. WELL NO.: 65-867

DATE: 03/60

FROM	TO (Feet)	DESCRIPTION
0	10	Clay Medium Sand Gravel
10	28	Stones Clay
28	42	Stones Clay Medium Sand
42	45	Gravel
45	62	Stones Clay Medium Sand
62	97	Medium Sand Stones Clay
97	101	Gravel
101	110	Stones Clay
110	117	Gravel
117	123	Stones Clay

Water Found - 138 Feet
Static Level - 12 Feet
Pumping Level - 66 Feet
Test Pumping Rate - 96 GPM
Test Time - 8/00 Hr/Min
Specific Capacity - 1.78 Gpm/Ft

Elev. of Water Found - 907 Feet
Elev. of Static Level - 1033 Feet

Water Quality - Fresh
Ground Elevation - 1045 Feet

WATER WELL NO.: 6

OWNER: City of Waterloo

M.O.E. WELL NO.: 65-865

DATE: 12/57

FROM	TO (Feet)	DESCRIPTION
0	7	Fill
7	41	Clay
41	46	Silt Medium Sand
46	53	Clay
53	57	Gravel Medium Sand Silt
57	64	Gravel Clay
64	65	Hardpan
65	73	Clay Gravel
73	84	Silt
84	89	Clay

Water Found - Feet
Static Level - Feet
Pumping Level - Feet
Test Pumping Rate - GPM
Test Time - Hr/Min
Specific Capacity - Gpm/Ft

Elev. of Water Found - Feet
Elev. of Static Level - Feet

Water Quality - Fresh
Ground Elevation - 1025 Feet

TABLE D-2 STRATIGRAPHIC AND INSTRUMENTATION LOGS

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: OW1-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 312.80 m
TOP OF PIPE ELEVATION: 312.636 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 1-81 FRICTION CAP; OW 1-81 THREADED PLUG; 1.27cm Ø PVC PIPE; 3.80cm Ø PVC PIPE; BACKFILL				
1	GREY PEBBLY SILTY FINE SAND FILL						
2	REFUSE - glass, wood, paper, metal scraps, carbon fragments & a tire in a black sandy matrix						
3							
4	MODERATELY WELL SORTED GREY PEBBLY SILTY FINE SAND			1	GS		
5			SCREENS 90 cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽ OCT. 6, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: OW2-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 314.22 m
TOP OF PIPE ELEVATION: 314.216 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 2-81 FRICTION CAP; OW 2-81 THREADED PLUG				
1	POORLY SORTED PEBBLY SILTY FINE SAND FILL		1.27 cm Ø PVC PIPE	1	GS		
2	REFUSE - glass bottles, cans, metal scraps, plastic bags, wooden sticks, bones & newspaper(1955) in a black sandy matrix		3.80 cm Ø PVC PIPE; BACKFILL; ▽				
3							
4	MODERATELY WELL SORTED GREY SILTY FINE SAND & PEBBLES			2	GS		
5			SCREENS 90 cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽ OCT. 6, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: GMP3-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 313.10 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 3-81 FRICTION CAP				
	GREY PEBBLY SILTY FINE SAND FILL		1.27cm Ø PVC PIPE				
1			BACKFILL				
	REFUSE - glass bottles, tin cans, metal scraps, & paper in a black sandy matrix						
2							
	POORLY SORTED GREY SILTY FINE SAND & PEBBLES			1	HS		
3			SCREEN 90cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME: Waste Site Identification Study
JOB Nº: 9-0913
CLIENT: Ministry of the Environment
HOLE TYPE: testhole
LOCATION: Site #0084 - Waterloo

HOLE Nº: GMP4-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 313.15 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 4-81 FRICTION CAP				
	GREY PEBBLY SILTY FINE SAND FILL		1.27cm Ø PVC PIPE				
1	GREY FILL & CONCRETE PIECES		BACKFILL				
2	REFUSE - glass & metal scraps in black sandy matrix						
	MODERATELY WELL SORTED GREY SILTY FINE SAND			1	GS		
3			SCREEN 90 cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: OW3-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 313.23 m
TOP OF PIPE ELEVATION: 313.834 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 5-81 FRICTION CAP; OW 3-81 THREADED PLUG				
	PEBBLY SILTY FINE SAND FILL		1.27cm Ø PVC PIPE				
1	REFUSE - two large logs, glass & metal scraps in a black sandy matrix		3.80 cm Ø PVC PIPE; BACKFILL ▽				
2							
3	COARSE GRAVEL						
	POORLY SORTED GREY PEBBLY SILTY FINE SAND						
4			SCREENS 90cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽ OCT. 5, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME: WASTE SITE IDENTIFICATION STUDY
JOB Nº: 9-0913
CLIENT: Ministry of the Environment
HOLE TYPE: testhole
LOCATION: Site #0084 - Waterloo

HOLE Nº: OW4-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 314.75 m
TOP OF PIPE ELEVATION: 315.056 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 6-81 FRICTION CAP; OW 4-81 THREADED PLUG; 1.27cm Ø PVC PIPE; 3.80cm Ø PVC PIPE; BACKFILL; ▽				
1	BROWN FILL						
	GREY FILL						
2	REFUSE - glass fragments, concrete pieces, metal scraps & bones in a black sandy matrix						
3							
	COARSE GRAVEL						
4	POORLY SORTED GREY PEBBLY SILTY FINE SAND			1	GS		
5			SCREENS 90 cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽ OCT. 5, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: OW5-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 315.30 m
TOP OF PIPE ELEVATION: 315.275 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL BROWN PEBBLY SILTY FINE SAND FILL		GMP 7-81 FRICTION CAP; OW 5-81 THREADED PLUG; 1.27cm Ø PVC PIPE	1	GS		
1	REFUSE - branches, small logs, bottles, metal scraps & newspaper(1957) in black sandy matrix		3.80cm Ø PVC PIPE				
	COARSE GRAVEL			2	GS		
2	POORLY SORTED GREY PEBBLY FINE TO MEDIUM SAND		BACKFILL				
3			SCREENS 90cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽ OCT. 5, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : WASTE SITE IDENTIFICATION STUDY
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: OW6-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 315.50 m
TOP OF PIPE ELEVATION: 315.482 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 8-81 FRICTION CAP; OW 6-81 THREADED PLUG				
	BROWN PEBBLY SANDY FILL						
	REFUSE - bricks, tar paper, glass, small logs, scrap metal, fibreglass & lineolium in a black sandy matrix		1.27cm Ø PVC PIPE				
1			3.80cm Ø PVC PIPE ▽				
	WELL SORTED BROWN MEDIUM TO COARSE SAND						
	COARSE SANDY GRAVEL		BACKFILL				
2	POORLY SORTED GREY PEBBLY SILTY FINE SAND						
3							

SCREENS 90cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH

CRA

WATER TABLE ▼
STATIC LEVEL ▽ OCT. 5, 1981

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: GMP9-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 317.15 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 9-81 FRICTION CAP				
	GREY PEBBLY SILTY FINE SAND FILL		1.27cm Ø PVC PIPE				
1							
	BURIED SOIL HORIZON		BACKFILL				
2							
	GREY PEBBLY SILTY FINE SAND						
3			SCREEN 90cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0084 - Waterloo

HOLE Nº: GMP10-81
DATE COMPLETED: September 1, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 308.90 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 10-1981 FRICTION CAP; BENTONITE SEAL				
1			1.27 cm Ø PVC PIPE	1	SS	8	
2	GREY SILTY FINE SAND FILL						
3			BACKFILL	2	SS	18	
4							
5	GREY SILTY CLAY			3	SS	22	
6							
7			SCREEN 60 cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0084 - Waterloo

HOLE Nº: OW7-81
DATE COMPLETED: September 1, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 310.15 m
TOP OF PIPE ELEVATION: 310.149 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	SOIL HORIZON		GMP 11-81 FRICTION CAP; OW 7-81 THREADED PLUG; 1.27cm ØPVC PIPE				
1	GREY PEBBLY SILTY SANDY FILL		BENTONITE; PEA GRAVEL	1	SS	5	
2	REFUSE - fragments of plastic and galss in black sandy matrix		3.80cm ØPVC PIPE; BACKFILL	2	SS	13	
3	GREY CLAY		PELTONITE				
4	WELL SORTED BROWN SAND LAYERS		PEA GRAVEL; CAVED - IN SAND	3	SS	32	
5			SCREENS 60cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER CLOTH				

WATER TABLE ▼
STATIC LEVEL ▽ OCT. 14, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0084 - Waterloo

HOLE Nº: OW8-81
DATE COMPLETED: September 25, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 326.34 m
TOP OF PIPE ELEVATION: 326.639 m

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		GMP 12-81 FRICTION CAP; OW 8-81 THREADED PLUG; BACKFILL; BENTONITE; BACKFILL				
1	GREY PEBBLY SILTY FINE SAND FILL		PEA GRAVEL; 1.27cmØ PVC PIPE	1	AS		
2	REFUSE - fragments of glass, charcoal, and wood in black sandy matrix		BACKFILL; 3.80cmØ PVC PIPE; PELTONITE				
3	BROWN CLAYEY SILTY SANDY FILL		PEA GRAVEL	2	AS		
4	WELL SORTED BROWN BEDDED SILTY FINE SAND						
5			BACKFILL				
6				3	SS	74	●
7			SCREENS 60cm LONG DRILLED PVC PIPE WRAPPED WITH POLYPROPYLENE FILTER				

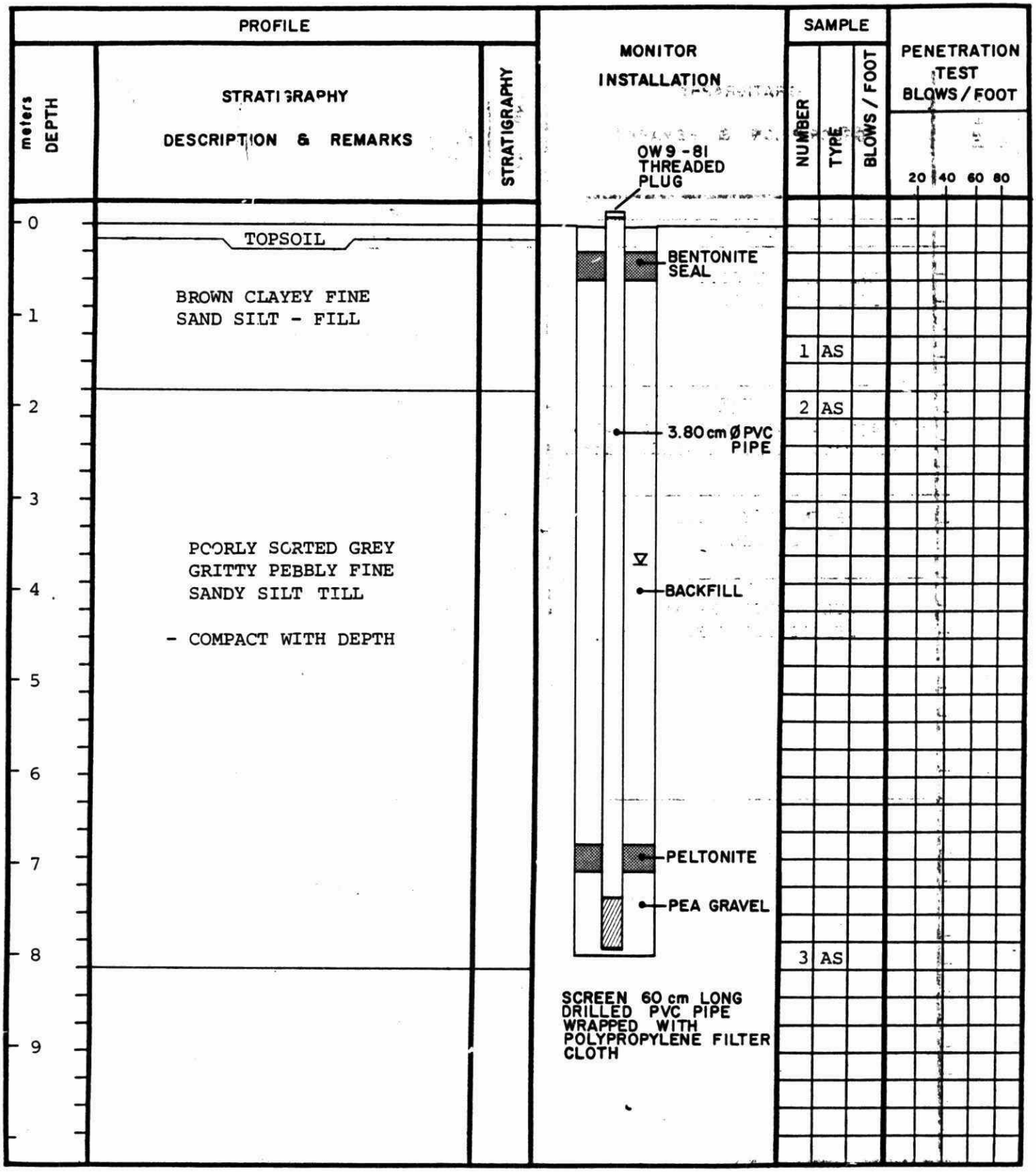
WATER TABLE ▼
STATIC LEVEL ▽ OCT. 5, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : borehole
LOCATION : Site #0084 - Waterloo

HOLE Nº: OW9-81
DATE COMPLETED: September 25, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 317.10 m
TOP OF PIPE ELEVATION: 317.070 m



WATER TABLE ▼
STATIC LEVEL ▽ OCT. 5, 1981

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: TH4-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 312.00 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		NO MONITORS				
1	GREY PEBBLY SILTY FINE SAND FILL						
2	GREY SILTY FINE SANDY TILL						
3							

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0044 - Waterloo

HOLE Nº: TH9-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 315.50 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH feet	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL		NO MONITORS				
	GREY PEBBLY SILTY FINE SAND FILL						
1	BURIED SOIL HORIZON						
	COARSE SANDY GRAVEL						
2	WELL SORTED BROWN PEBBLY FINE TO MEDIUM SAND			1	GS		
3							

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: TH12-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 316.90 m
TOP OF PIPE ELEVATION:

PROFILE				MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
DEPTH meters	STRATIGRAPHY DESCRIPTION & REMARKS		STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	TOPSOIL			NO MONITORS				
	BROWN PEBBLY SILTY SANDY FILL							
1	POORLY SORTED BROWN PEBBLY SILTY CLAY - VERY COMPACT							
2					1	GS		
3								

WATER TABLE ▼
STATIC LEVEL ▽

CRA

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : Waste Site Identification Study
JOB Nº : 9-0913
CLIENT : Ministry of the Environment
HOLE TYPE : testhole
LOCATION : Site #0084 - Waterloo

HOLE Nº: TH13-81
DATE COMPLETED: August 24, 1981
GEOLOGIST/ENGINEER: WSC
GROUND ELEVATION: 315.05 m
TOP OF PIPE ELEVATION:

PROFILE			MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
meters DEPTH	STRATIGRAPHY DESCRIPTION & REMARKS	STRATIGRAPHY		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
0	BROWN PEBBLY SANDY FILL		NO MONITORS				
1	BROWN PEBBLY SANDY FILL						
2							
	GREY PEBBLY SILTY FINE SAND						
3							

WATER TABLE ▼
STATIC LEVEL ▽

CRA

TABLE D-3

PHASE II - PART I STUDY REPORT

FOR SITE NO. 0084

PREPARED BY:

GARTNER LEE ASSOCIATES LIMITED

NOVEMBER, 1980

GENESTOGA-ROVERS & ASSOCIATES LIMITED

SITE 0084

WATERLOO SEWAGE TREATMENT PLANT
AT UNIVERSITY AVENUE

CONCLUSIONS AND RECOMMENDATIONS

Clean fill covering ash and garbage seems to be over 5 feet deep locally and is difficult to penetrate with the hand auger. Garbage was encountered at Gas Probe 2 only, but no methane was present. However, gas was detected in the water valve box within the garbage at 17%. Also leachate appears to have entered the tributary to Laurel Creek as evidenced by elevated indicator parameters.

The sandy nature of the soils between the garbage and the houses on Dale Avenue coupled with the other indicators is sufficient evidence to warrant placement of two monitors as shown on the plan. These should be checked monthly through one winter.

Water samples checked for indicators at Stations 2 and 3 are showing some effects of garbage. As such samples have been submitted to a laboratory for more detailed analysis. Once data are availabie, further direction will be given.

CONESTOGA-ROVERS & ASSOCIATES LIMITED

SITE 0084

SEWAGE TREATMENT PLANT
A3
pond
laurel cr
C7
MH
A1
C1
C5
C2
A2
C6
MH
ash
valve box
D1
D2
D3
C4
C3
park
DALE
UNIVERSITY AVE
HWY 95
SCALE 1:5000
LEGEND
A1 Surface water sampling stations
C1 Test hole locations
D1 Gas tests - buildings & services
Proposed monitors
Suspected original waste boundaries

Ministry of the Environment
Ontario

(To be completed in duplicate, 1 copy to MOE Regional office, 1 copy to MOE Head office)

FORM I
(Site Identification Stu

SITE INSPECTION

MOE REGION WEST CENTRAL DATE September 23 & 24, 1980 SITE IDENTIFICATION CODE 0084

SITE WATERLOO SEWAGE TREATMENT PLANT AT UNIVERSITY AVENUE AND HIGHWAY #85
(Lot, concession #, or UTM coordinates, name, address)

ON-SITE TESTS

I Leachate

A. WATER BODIES WITHIN 100 METRES

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides	60	210	300							
2) Dissolved solids										
3) Iron	1.5	<.2	.7							
4) Alkalinity	154	376	205							
5) Conductivity	400	850	1650							

B. WELLS WITHIN 100 METRES N/A

Parameter	Results 1	2	3	4	5	6	7	8	9	10
1) Chlorides										
2) Dissolved solids										
3) Iron										
4) Alkalinity										
5) Conductivity										

Any significant odour problems Yes ____ No X Comments

LAB TESTS (2 LITRE SAMPLES)

Required, Yes X No ____ If Yes, complete Form II, Lab Analysis. If No, go to Part II, Gas.

II Gas

N.D. - NO GAS DETECTED
N.A. - NO ONE AT HOME
N.D. - NO GAS DETECTED

C. ON-SITE

Test Holes	Results	Test Holes	Results
#1	N.D.	#6	N.D.
#2	N.D.	#7	N.D.
#3	N.D.	#8	
#4	N.D.	#9	
#5	N.D.	#10	

D. BUILDINGS

Name/Address	Results
1. 357 DALE CRESCENT	N.A.
2. 357 DALE CRESCENT	N.D.
3. 359 DALE CRESCENT	N.D.
4.	
5.	
6.	
7.	
8.	
9.	
10.	

III General Comments (vegetation, leachate springs, depth, etc.)
VALVE BOX (WATER) VB1 ON PLAN) HAD 17.5% GAS - NO GAS DETECTED IN MAN HOLES.

(Detail all test point locations in a sketch on reverse side)

Form completed by: Grant Lindsay

MOE 1640A/80

SUPPORTING DATA

BACKGROUND:

Site filled prior to 1957. It looks like garbage was placed on the flood plain of Laurel Creek. Garbage may have been burned as samples from auger appeared like bleached ash. When sewage treatment plant was built, clean fill was taken from plant and placed on top of garbage - looks like over 5 feet in most places.

GEOLOGY:

Site is located on alluvium of Laurel Creek flood plain. Former banks of creek appears to be developed in sand kame deposits. Fills vary throughout the creek area but best estimate of garbage is shown.

DRAINAGE:

Site proper is well drained and covered with over 4 feet of clean fill. Laurel Creek bisects site. A small tributary stream enters Laurel Creek near University Avenue as shown on plan.

VEGETATION:

Site is grassed and well kept. No signs of erosion. Trees appear fine with exception of one very old maple located at west edge of fill. This tree appears to be dying.

LEACHATE:

No signs of leachate springs anywhere.

AUGER HOLE LOGS
SITE 0084

C1

0	- 1.37 m	Predominatly brown silty sand fill, Odd stones No gas detected

C2

0	- 0.46 m	Clean silt and sand fill
0.46	- 1.22 m	Mixed garbage - paper, metal, glass, plastic, very decomposed like ash that is bleached No gas detected

C3

0	- 0.61 m	Grey brown silt fill
0.61	- 1.53 m	Brown fine sand, odd stone Wet at 1.22 m Water slowly seeping in hole No gas detected

C4

0	- 1.22 m	Clean medium sand, dry
1.22	- 1.53 m	Clean silt till, moist No gas detected

C5

0	- 0.15 m	Black topsoil
0.15	- 1.22 m	Clean grey brown clayey silt, sand lenses - looks like native soil No gas detected

C6

0	- 1.22 m	Clean sand and gravel No gas detected

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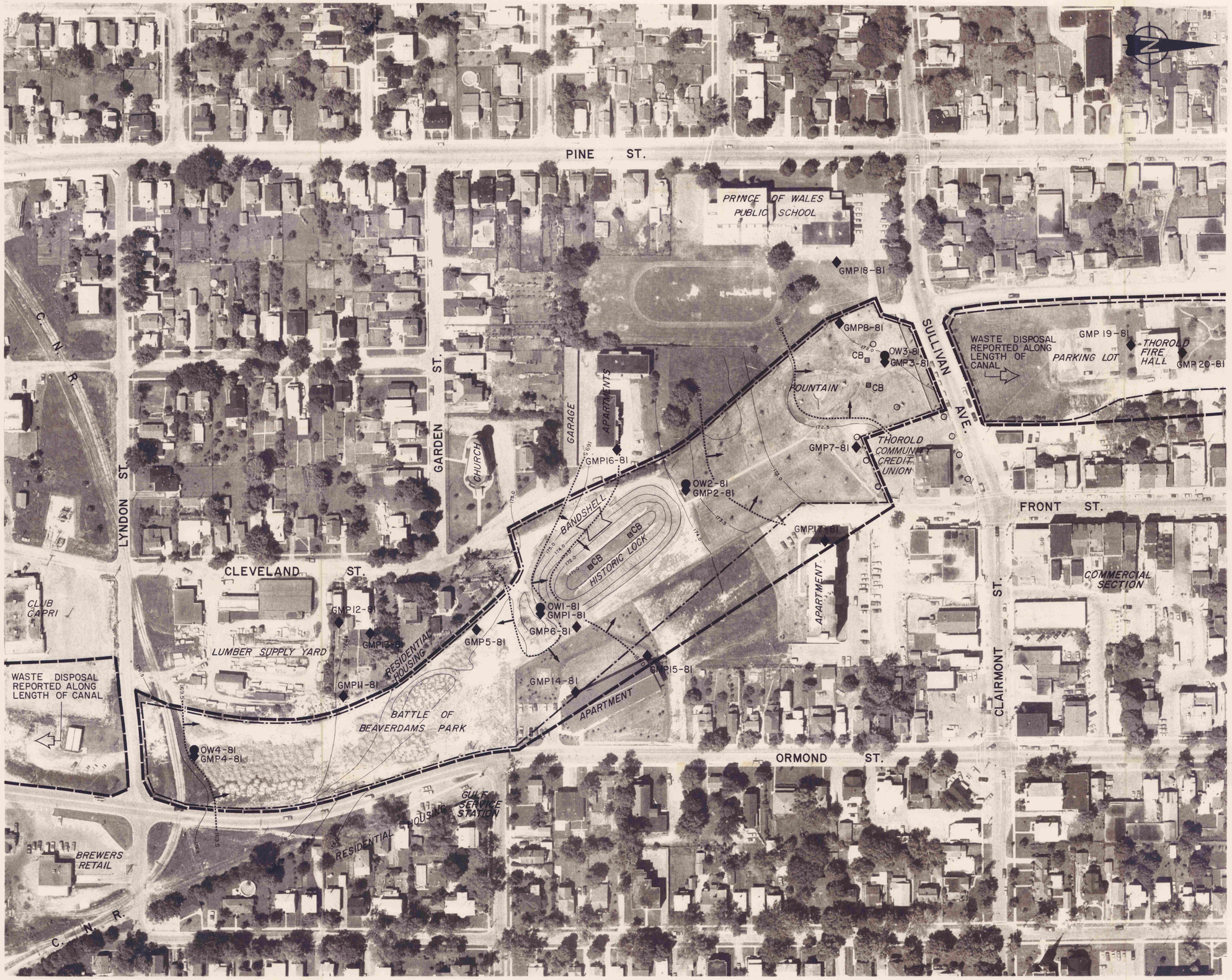
C7

0	- 0.76 m	Sand and gravel
0.76 m		Refusal on boulder
		No gas detected



LEGEND

- LIMIT OF REFUSE
- INFERRED LIMIT OF REFUSE
- LIMIT OF INVESTIGATION
- 176.0 ELEVATION (m AMSL)
- OW1-81 OBSERVATION WELL
- GMP1-81 GAS MONITORING PROBE
- TH1-81 TESTHOLE
- SP1-81 SURFACE WATER SAMPLING POINT
- DIRECTION OF GROUNDWATER FLOW
- SWALE
- 169.0 POTENTIOMETRIC SURFACE (JUNE 22, 1982)
- PASSIVE GAS VENT

PHOTO BASE MAPPING PREPARED BY NORTHWAY-GESTALT CORPORATION FLOWN AT 5000' IN SUMMER 1978.

Ministry of the Environment
Ontario

Waste Site #0044-Thorold
SITE PLAN 1

WASTE SITE IDENTIFICATION STUDY
Phase II Part I
Verification Studies
West Central Region

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES LIMITED
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

Drawn by:	Checked by:	Project No.	Date:
G.R.H.	A.J.C.	9-0913	AUGUST 19, 1982

Scale: 1 : 1000 (0 10 20 30 40 50 m)

Drawing: map 3.1

(25)

LEGEND

- LIMIT OF REFUSE
- INFERRED LIMIT OF REFUSE
- LIMIT OF INVESTIGATION
- 320.0 — ELEVATION (m AMSL)
- OW1-81 — OBSERVATION WELL
- GMP1-81 — GAS MONITORING PROBE
- TH1-81 — TESTHOLE
- SP1-81 — SURFACE WATER SAMPLING POINT
- DIRECTION OF GROUNDWATER FLOW
- SWALE
- 310.0 — POTENTIOMETRIC SURFACE (JUNE 7, 1982)

PHOTO BASE MAPPING PREPARED BY NORTHWAY-GESTALT CORPORATION FLOWN AT 4000' ON NOVEMBER 12, 1979.

Ministry of the Environment
Ontario

Waste Site #0084 - Waterloo
SITE PLAN

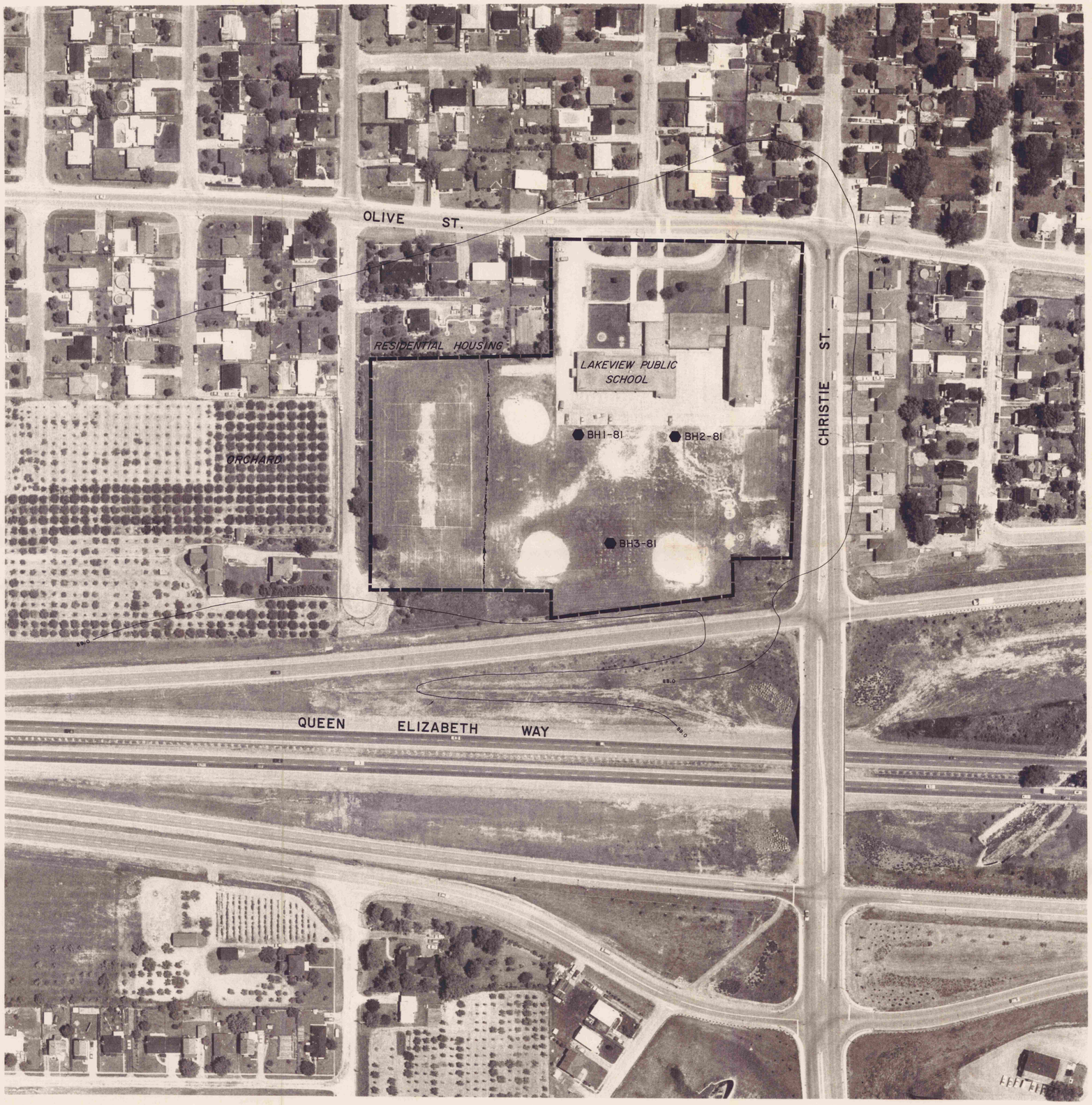
WASTE SITE IDENTIFICATION STUDY
Phase II Part I
Verification Studies
West Central Region

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES LIMITED
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

Drawn by:	Checked by:	Project No.	Date:
G.R.H.	A.J.C.	9-0913	AUGUST 19, 1982

Scale: 1:2000 (0 10 30 50 100 m)

Drawing: map 5.1



N

LEGEND

- LIMIT OF INVESTIGATION
- 88.0 ELEVATION (m AMSL)
- SWALE
- BH2-81 BOREHOLE
- DIRECTION OF GROUNDWATER FLOW

PHOTO BASE MAPPING PREPARED BY NORTHWAY-GESTALT CORPORATION FLOWN AT 5000' IN SUMMER 1978.

Ministry of the Environment
Ontario

Waste Site #0062 - Grimsby
SITE PLAN

WASTE SITE IDENTIFICATION STUDY
Phase II Part I
Verification Studies
West Central Region

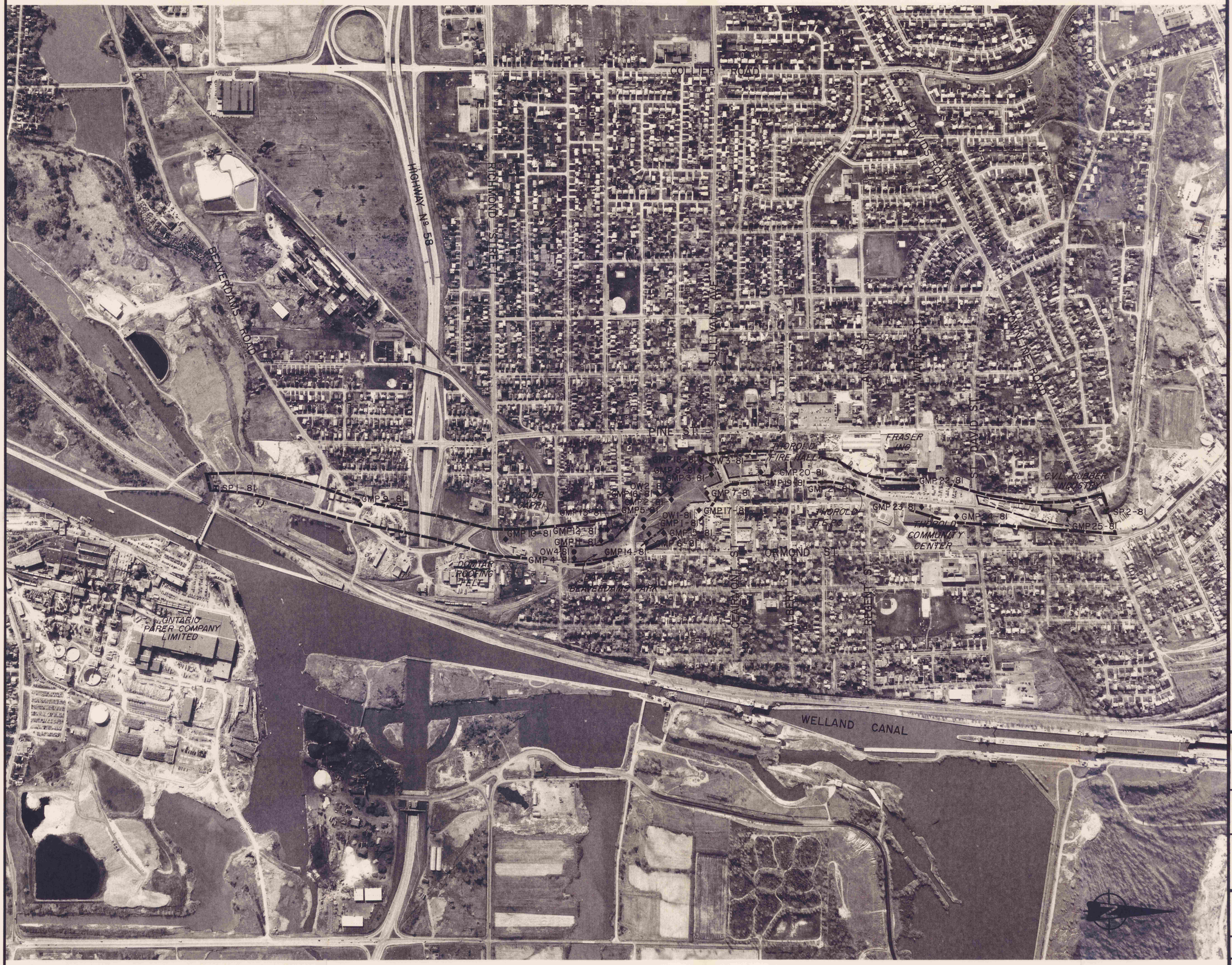
CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES LIMITED
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

Drawn by:	Checked by:	Project №:	Date:
G.R.H.	A.J.C.	9-0913	NOVEMBER 9/81

Scale: 1:1000 meters
0 10 20 30 40 50 m

Drawing: map 4.1

(25)



LEGEND

- ● OW1-81 OBSERVATION WELL
- ◆ GMP1-81 GAS MONITORING PROBE
- ⊠ SP1-81 SURFACE WATER SAMPLING POINT
- LIMIT OF INVESTIGATION
- LIMIT OF REFUSE
- INFERRED LIMIT OF REFUSE

PHOTO BASE MAPPING PREPARED BY NORTHWAY - GESTALT CORPORATION FLOWN AT 10,000' ON APRIL 16, 1981.

Ministry of the Environment
Ontario

Waste Site #0044 - Thorold
SITE PLAN 2

WASTE SITE IDENTIFICATION STUDY
Phase II Part I
Verification Studies
West Central Region

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES LIMITED
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

Drawn by:	Checked by:	Project No	Date:
G.R.B.	A.J.C.	9-0913	MARCH 4, 1982

Scale: 0 100 200 300m
SCALE: 1/5000

Drawing: map 3.2

TD
897.5
.W37
W47
1983
phase II
part II

Waste site identification study :
west central region.

76888